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Product Engineering

McG W-HILL MAGAZINE OF DESIGN
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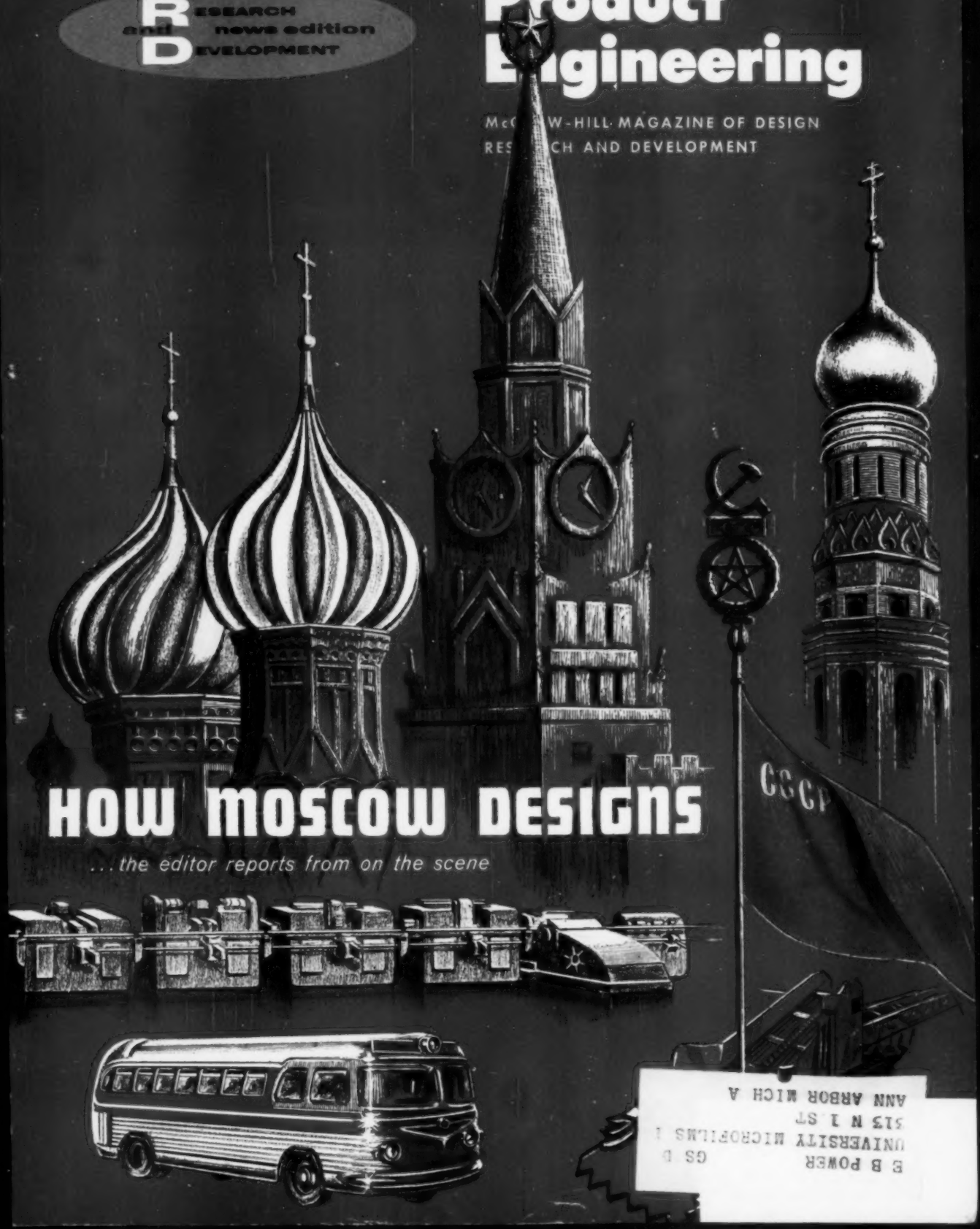

HOW MOSCOW DESIGNS

... the editor reports from on the scene

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HOW MOSCOW DESIGNS

...the editor reports from on the scene

Americans, particularly since last October 4, have been deeply concerned about the Soviet Union, particularly in its methods of engineering design. Many articles and books have been written on the subject, but it is one thing for a newspaper reporter to study an automobile assembly line and a very different thing when a trained engineer talks with Soviet researchers and academicians in their own laboratories.

This report is the result of our chief editor's just-ended visit to Moscow. It is his eye-witness account and evaluation of the many phases of life and industry that have combined to make the Soviets first in space and often unbelievably primitive on the ground.

Rather than spread this information over six months of PRODUCT ENGINEERING, we have taken the unprecedented step of devoting this entire issue to the one subject.

—THE EDITORS

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  Counterweights, flywheels and radiation shields made of high-density materials.

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  Rene 41, in sheet form, compared to other high-strength alloys.

- **Drum camera to record motion**
  Fast-moving parts record their acceleration and velocity for study.

- **Goodby ammonia fumes in the print room**
  Switch from gas in solution to gas in bottles, to clear the air.

Product Engineering

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R and D RESEARCH and DEVELOPMENT news edition

July 14, 1958 Vol. 29, No. 28

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ABP JULY 14, 1958 Product Engineering A McGRAW-HILL PUBLICATION Vol. 29, No. 28 ABC

PRODUCT ENGINEERING is published weekly,—with an additional Design Digest Issue in Mid-September, by McGraw-Hill Publishing Company, Inc, James H. McGraw (1860-1948), Founder. PUBLICATION OFFICE, 99-129 North Broadway, Albany 1, N. Y. See panel below for directions regarding subscription or change in address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Joseph A. Gerardi, Executive Vice-President; L. Keith Goodrich, Vice-President and Treasurer; John J. Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Joseph H. Allen, Vice-President and Director of Advertising Sales; A. R. Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and consultants engaged in the design of machinery and the other engineered products. **Position and company connection must be indicated on subscription orders. Send to address shown in box below.**

United States subscription rate for individuals in the field of he publication, $5.00 per year, single copies, 50 cents; Canadian subcription $7 per year; foreign $25 per year, payable in advance. Second-class mail privileges authorized at Albany, N. Y., U.S.A.

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PRODUCT ENGINEERING articles are indexed in both the **Industrial Arts Index** and the **Engineering Index**. PRODUCT ENGINEERING publishes its own semiannual index including the Design Digest Issue. Copies are obtainable on request to the Editor.

SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfillment Manager, PRODUCT ENGINEERING, 330 W. 42nd St., New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address giving old as well a new address, and including postal zone number if any. If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

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because we need to know . . .

So many questions have been asked about the USSR, and so much of our content has referred to, or been a result of, Russian advances, that I felt we should have a more intimate knowledge of the Soviet Union.

So I went. Behind that simple statement is a great deal of frustration and complication that has no place here. The simple fact remains that the USSR is fascinating and informative. We try to bring you some of both in the pages that follow.

My mission was engineering, not politics, so you will find almost no references to politics or the international situation in these articles. What I have attempted to do is to establish a frame of reference, then to report engineering developments, as I saw them, within that frame.

If the lack of a "business community" as we know it confuses you, it may be helpful to consider the USSR as a great corporation, American style, with one added feature—police power. Its top structure is like that of a corporation, its organization is, it rewards its "employees" similarly, it has recently faced comparable problems in decentralization, modernization, education, selection and advancement. Off-beat requests are similarly passed upward for review and decision. It is vital for the visitor to realize that everyone to whom he talks works for, and is a partner in, the "corporation." Its competitive situation, its slowness in one instance and speed in another, its blind spots and over-management, its red tape, its ability to concentrate in a given direction—all these are similar to corporate operations.

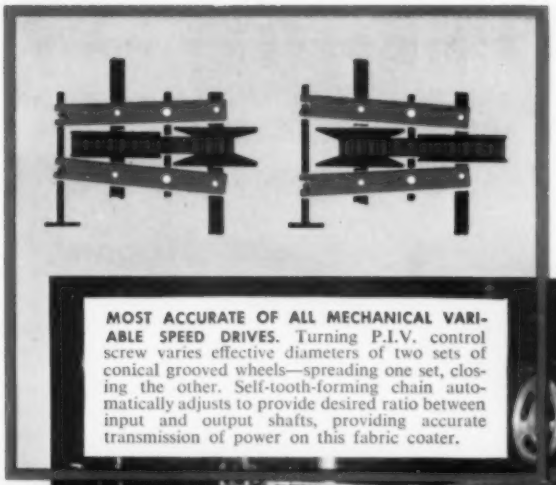
This is a land of terrific contrasts, where the new and the old co-exist. But it is moving forward, and at terrific speed. Its engineers and scientists look like ours and talk like ours, and its plants seem to have more nearly the same objectives than in any other country I visited, the same methods (where possible), even the same physical setup. The thinking is straightforward: originate where necessary, copy the best available where you can, skip intervening steps others have made.

Leapfrogging of normal developmental steps is natural in a society that leapfrogged the Industrial Revolution, going directly from feudalism to the present day. In aircraft, for example, the USSR has jumped from the 2-engine transport to the jet, skipping the 4-engine type as economical but obsolescent. In machine tools, current designs for original types have standard table heights and feed arrangements, so the same machine can be operated singly or made part of a transfer line. Dozens of other examples can be quoted. It is important to remember, however, that leapfrogging can be done only by the country that has someone else to copy. Someone must take the necessary evolutionary steps. The USSR, with no patent system, no competitive enterprise, has no qualms about copying anything suitable and good. There is no opprobrium attached to this procedure in the practical Soviet mind; it simply means that development time is shortened, and the energy and ability of top engineers can be concentrated in the fields which are special or in which the Soviet Union is as good as, or better than, its contemporaries.

I was fortunate in the opportunities offered me for visits—they all fitted together into a picture. My longest visit was at ENIMS—the machine-tool institute—which Nevin Bean, automation expert of Ford Motor Co., characterizes "the most important key to future Russian advances" (*PE—June 23, p 25*). From engineers there, I received more data than they have ever previously given. I toured the USSR's largest auto plant, the two biggest technical exhibits. I met academicians, scientists, editors, officials, all of whom contributed to this picture. And I met many of the ordinary people, who are a very important part of it.

No one, at any point, failed to answer my questions, prohibited my taking of pictures (except in one plant and about airfields), or going where I liked (if I could get an appointment). The conditions were about what they'd be if my Soviet opposite number came here.

So here is an engineer-journalist's picture—superficial and quick because of time and my own inadequacy, perhaps, but creating a picture nonetheless, of the industrial country that can create a sputnik and copy an automobile.



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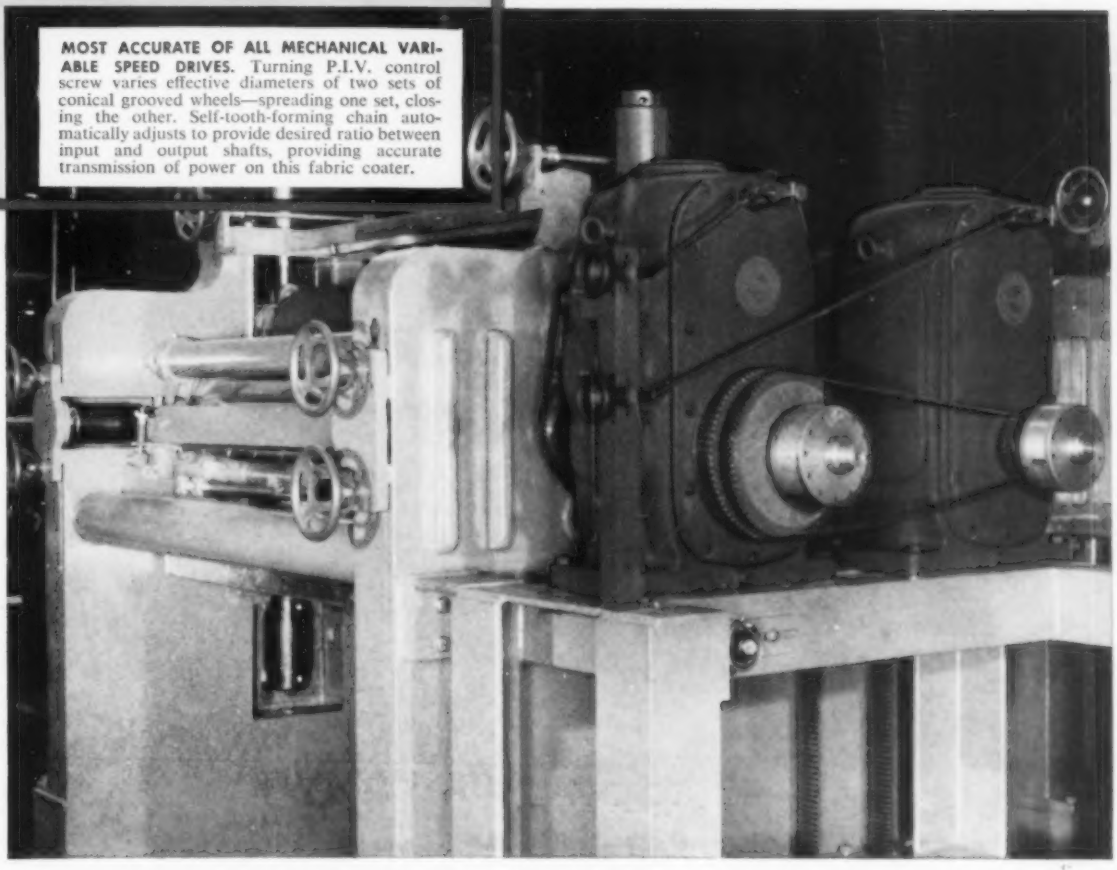

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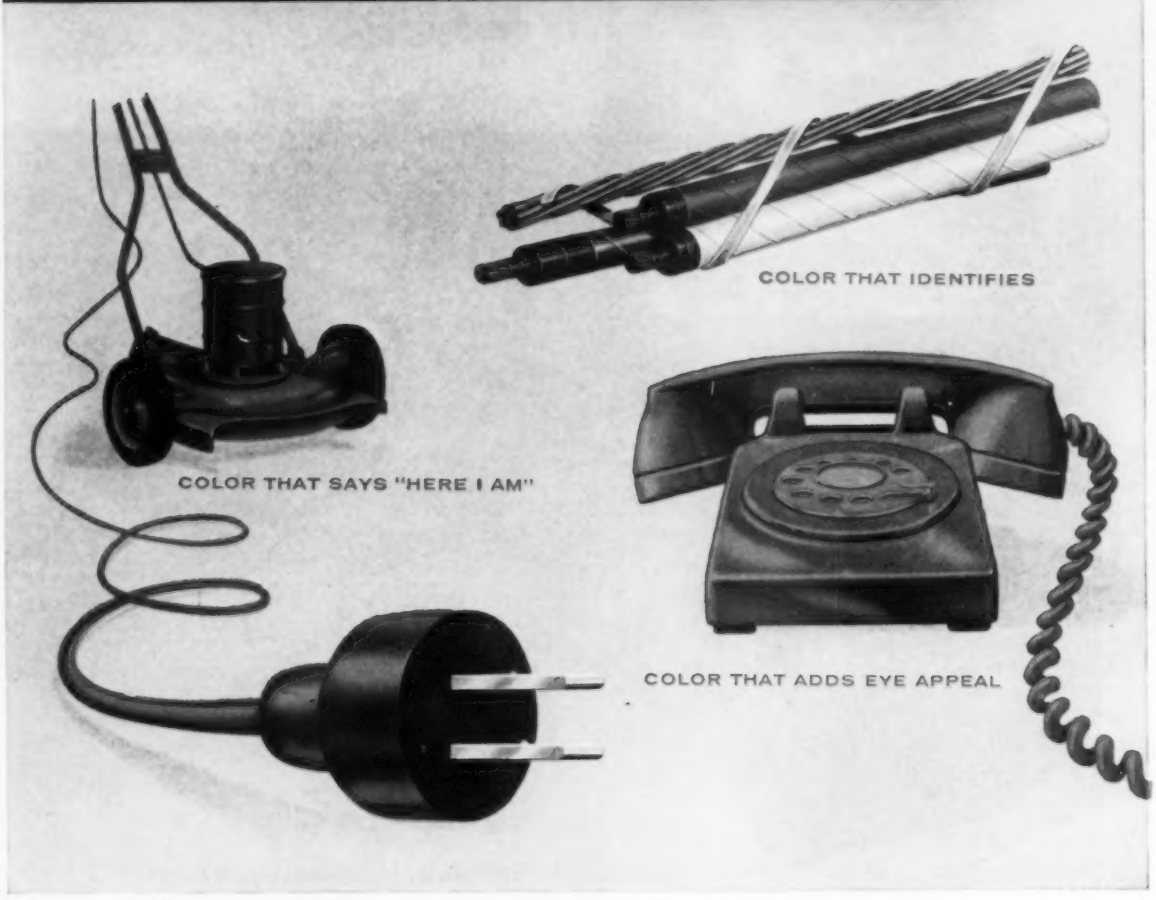

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FIRST—
the frame of reference—
MOSCOW TODAY

The USSR is the land of the paradox—where the past and the future walk side by side. Historians and analysts have both remarked this characteristic, and recent events have spotlighted it. Tremendous advances have been made since the Revolution, but in many ways the USSR is still Russia.

The greatest problem for any western observer is to view what he sees without prejudice—within its own frame of reference. Only then can he begin to understand. What follows is only a beginning, and it is limited to the capital city and the area immediately surrounding it. It is the equivalent of a similar Soviet analysis based on a 2-week visit to New York and its environs, with perhaps a bit of Washington and of Chicago thrown in, because Moscow is both the capital and the major city, the financial heart and the largest manufacturing and marketing area. This is, in any case, a frame of reference for the engineering descriptions that follow.

MOSCOW—THE CITY

Paradoxes begin with the city itself. It has broad avenues and beautiful buildings, careful planning and planting to overcome the fact that it is, like most of the USSR, essentially flat, low ground. It was practically undamaged in the World Wars, has not suffered major damage in a long time. Thus a surprising number of historical monuments, crammed with art and artifacts, remain to be seen. Its major streets and public buildings are kept clean and bright by armies of workmen and workwomen; there are a number of parks; flowers and trees, fountains and statues are widely distributed and well tended—all three street-sprinklers I saw had their nozzles inverted and were watering roadside park areas.

But the ordinary buildings are multi-story flats with courts, faced with concrete stucco and painted a uniform mustard yellow. Courts and back streets are as drab and dirty as those in our big cities, and buildings are more dilapidated. In some areas, there are still the log buildings typical of the countryside. At first, these buildings were torn down to make room for blocks of apartments lining wide avenues; now a whole new area southwest

BROAD, TREE-LINED avenues, frequently almost empty of cars; square boxy buildings of mustard-colored stucco—these contrast sharply with the spires of the Kremlin at center rear and the stone building (office of Stanki i Instrument, machine-tool magazine) from which this picture was taken.

WOMEN ARE 51% of the population, and they do their full share of the work. Here one coils up a heavy hose after washing the sidewalk and terrace at my hotel. Note the girl in modern dress, the older woman in traditional shawl. Time: 7 A.M.

AUTOMATIC DISPENSERS are available here and there, joining the automatic coin-operated telephones. This battery dispenses drinks. Note the boots on one soldier, wide-bottom trousers on the other, a pigtailed schoolgirl.

PEOPLE MEET at the fountain in the center of GUM, busy state department store. It is really a series of small shops on two floors of a double 4-story arcade, with cross aisles. Upper floors are for storage. Here are girls in modern dress, women in head scarf and felt shoes, men in coats and men without.

A TREMENDOUS SCULPTURE diorama fills the far end of the main corridor of the principal building at the Agricultural Exhibition. It symbolizes the peoples of the USSR marching ahead together. The background is, however, not agricultural.

THIS PAINTING of the Resurrection, in the Tretyakov Gallery, is a recognized masterpiece. Tremendous, like many things in the USSR, its size can be judged by comparison with the head of the woman in center foreground. The artist made 600 preliminary sketches, many of which are on display around it.

of the city is being developed, with apartments like our cooperative developments, having their own stores and schools. This area alone will house 500,000 people.

TRAFFIC

The passenger automobile has not yet preempted the streets, and parking is no problem anywhere. There is a lot of surface traffic, but most of it is dark-green trucks, yellow buses and trolley buses. Trucks with wooden half-bodies haul everything from steel to families on the move. Bicycles, scooters and motorbikes are not nearly as common as in the other capitals of Europe, nor is the small car. Automobiles are mostly black, although the newer small cars are in colors—even in 2-toned combinations now that they are available for personal purchase. The station wagon is a rarity, the convertible almost non-existent.

Most drivers of passenger automobiles are men in Moscow (a surprising number of women drive trucks and taxis). It is amusing to note that even there men have the traditional fear of women as drivers. Once my host hoped I wouldn't be concerned; his driver was a woman. His apology was justified—she made several mistakes, and eventually brushed a boy tourist within the Exhibition grounds, then took the lad to task for backing into her. Later that same day, a drunk, just missed by the car ahead, panicked and leaped directly in front of us. The driver (male this time) missed him by a millimeter because the street was wide, shrugged and made a quip in Russian that was lost on me.

Arm signals are not used, and traffic signals are disregarded by both cars and people, unless it's a major intersection and there is a militiaman on duty. (Moscow has no police in the accepted sense. Police duties are handled by militiamen in blue uniforms, trimmed in red, and armed with white batons. The uniform is like that of the regular army, except for color.) There are no left turns on major avenues—you make a right turn, drive to the middle of the block and make a U turn from one inside lane to the other. There are no speed limits for passenger cars, except on certain streets; trucks are limited to 60 kmph (37.5 mph).

The pedestrian is fair game, but actual car speeds are low, so there are few accidents. Main streets are extremely wide—Gorky was widened from 14 meters (47 ft) to 50 meters (165 ft) in the Thirties, for example—so dodging and cowboy riding are the rule.

Signboards are infrequent—they sell Communism, peace, entertainments, traffic safety and the like. Store fronts carry only an identifying name for the merchandise sold—drugstores, for example, are numbered. There are many watch-repair shops, testifying to the Soviet love of wristwatches. There are tasteful displays in windows of larger stores, but without the usual signs in most cases—just the prices. There are also neon and flashing signs, but mainly for entertainment spots like theatres. Most conspicuous at night are the lighted Red Stars atop neo-gothic spires on such buildings as Moscow University, the Foreign Ministry, and my hotel, as well as over the Byzantine spires of the Kremlin. Moscow is laid out like a wheel radiating from the Kremlin, and many of these big new buildings are spaced around its periphery.

NEO-GOTHIC magnificence characterizes my hotel, the Leningradsky. Above is the entrance to the elevators, at right the entrance stair to one dining room.

HAND-CARVED DOORWAY, in the exhibit of peasant handicrafts at Zhagorsk Monastery, 95 km from Moscow, typifies the preservation of all artifacts. The lady with head scarf is a typical guard.

MANY CLOTHES are still washed beside a stream in rural Russia. These are the boards used to beat dirt out of clothes, on exhibit at Abramtesov. And many people still wash at the corner pump, to save carrying water home.

THE METRO

The Metro, Moscow's subway, is also laid out as a series of spokes, with a circular connecting route part way out. Stations are less closely spaced than ours and much more elaborate. They are big, clean and beautifully executed in marble, with chandeliers instead of fluorescent lights. One even has mosaics in the ceiling and is grander than anything in the city except the University. Trains are cleaner, faster and quieter than those in New York, with overhead rails to grasp rather than straps. There are special compartments for children and old people. Stations are reached by steep, fast escalators.

Like my hotel, the Metro was built to show the people the promised future. It is extravagant, luxurious, and the fare is only half a ruble (12.5 cents at official, 5 cents at tourist, exchange). When I asked my interpreter why so much luxury was put underground, she said: "Two million people use the Metro each day. They should see something beautiful!"

This idea—or the more practical propagandistic one of suggesting that someday all Moscow will be grand and beautiful—is also followed out in building new public buildings, new streets, and the Agricultural Exposition, which operates six months of the year and is bigger than the World's Fair in Brussels. More about this later, but Moscow has become the tourist mecca for Soviet citizens—the promise of tomorrow.

THE PEOPLE

Streets are so crowded with these tourists, it is hard to determine the true Muscovites. Tourists include many Asians, with blue cotton padded jackets and bloused trousers, felt slippers and the like, as well as many wearing the traditional boots and all manner of costumes, some new, some old, some fine, some shoddy. Moscow people dress simply, the men in suits that often look too big, the women in a variety of dresses, mostly inexpensive, and with shoes in great variety. No bleached hair, makeup (except for lipstick) and blatant jewelry. Children do most of their playing in their own courts or at schools and culture centers, so they don't appear on streets except in shepherded groups on their way to a museum. They are quiet and well-mannered.

A couple of youngsters hung around my hotel with lapel pins and medals to trade for coins, but that was all I saw no "hoods," no gangs, few overdressed (and NO underdressed) girls, and no beggars. Sex is apparently played down; there are no pinups in plants, no salacious jokes. Drunkenness is a problem, however, but no greater than in equivalent areas of New York.

Every Soviet man collects lapel buttons—even if he has no lapel. These include Lenin medals, badges for each republic and for each organization. I received three, one at ENIMS, one at Likhachjov, one at the Industrial Exhibition. They are badges of honor in the USSR, denoting attainment.

Major streets are continually patrolled both by mechanical sweepers and by the little old women with their hand-made twig brooms. Even cigarette butts are picked up (Russian cigarettes of the most popular type have about 1¼ in. of black tobacco and 3 in. of hollow "filter" stem.) There aren't too many butts, though—people don't smoke on streets much. There are no beer cans. There is no dog dirt—almost no dogs. But the sidewalks have gutters across to carry rainwater from downspouts, covers for utilities and guards for basement windows may be missing, and walks may not be level—the unwary pedestrian is responsible for his own falls.

MAINTENANCE PROBLEMS

Maintenance is still—as always—the Russian bugaboo. Faucets drip, stairs are chipped and cracked, treads are missing, stucco is spalled, paint faded and so on, except in

the Metro. *That* is spotless. But in my hotel bathroom, for example, the basin had no plug, the toilet ran continuously, the tub leaked onto the floor, which had a wood grill to keep my feet out of it, and the walls were peeling. Cracks between fixtures and tile wall had been repaired with ordinary cement. The basin was at an angle. This in a hotel with marble pillars in each of its two main dining rooms and the huge entrance hall, with crystal chandeliers and statuary all over the place, lounges on each of its 20 or more floors–one of two new showplace hostelries for Soviet (not foreign) VIP's.

This lack of maintenance and almost rude disregard for personal safety is also evident in the factories. Floors are cluttered and broken, stairs steep, dark, slippery, narrow. There are endless projections, no guards, often poor lighting, loads (for men and women) far over our permitted maximums. I saw no safety glasses–and plenty of bandages. Every plant has trees, flowers, bushes, benches and the like in a small park, but the whole area usually needs more gardeners and lawn mowers.

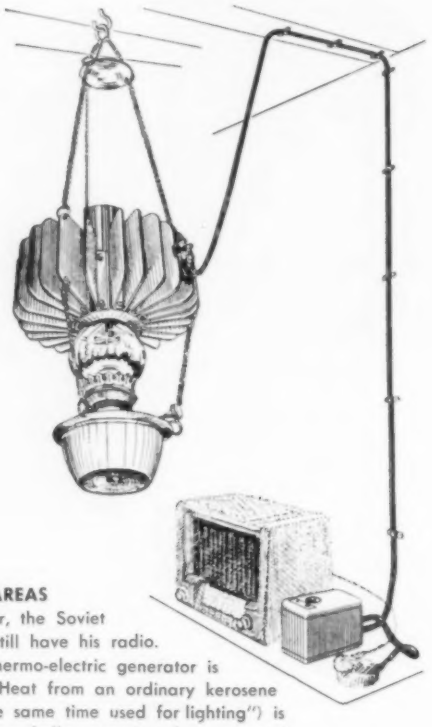
Rolling stock on the railroads is a conglomerate of types and sizes, all dirty dark red or black, drawn by diesels, steam locomotives (converted to oil from coal), and funny little ancient locomotives–all on the same line.

This is perhaps the key to many of the paradoxes–the USSR is still short of everything. People still queue up for special things–fresh bread, dress gloves, fruit. (My interpreter explained this was "because the clerk had gone to dinner", but it happened at all times of the day, even in GUM, the state department store.) There aren't enough trucks–so horse-drawn wagons and carts are common (albeit the wagons are rubber-tired). There aren't enough apartments, so people live in cramped quarters. There aren't enough street sweepers–so women supplement trucks. Macadam is the standard avenue surface and is laid by machine–but women lift and relay the cobbles in the Kremlin. The number of telephones is increasing so fast that circuits are overloaded and noisy and there isn't even an old phone book available (every office makes up its own). There aren't enough typewriters, so clerks write longhand records; not enough business machines, so records are kept in journals as we did 75 years ago; not enough cash registers or adding machines, so clerks use the abacus in stores, hotels, etc. Toys in stores (no guns, no tanks) are, in general, cheap and poorly made–except the scientific ones, which show real care.

I could go on, but it would be more of the same. *The key point is that where the modern equipment is vital, or where it has propaganda value—there it is.* GUM has plenty of cash registers, for example; Moscow University has excellent kitchen facilities, toilet and shower for each pair of student rooms. And the new southwest apartment area has buildings spaced around play areas and containing its own stores and schools, just as our housing developments do. A Metro arm will serve it and the University by December.

RURAL AREAS

The paradox continues outside Moscow. Main highways are as wide and as well done as ours, although pavement is not as heavy. But sideroads are cobbles or dirt



IN RURAL AREAS without power, the Soviet citizen may still have his radio. This 3-watt thermo-electric generator is the answer. Heat from an ordinary kerosene lamp ("at the same time used for lighting") is picked up by a hollow metal rod on a metal chimney and conveyed to two thermopiles, each having a number of thermocouples in series. One thermopile powers the filament, the other the plate through a vibrator pack with its voltmeter, pilot light and a switch. Kerosene consumption is only 60 to 70 gm/hr.

DESIGNERS are getting around to the orchard, too. Here's the latest in sprayers, which delivers 86 litres/minute from a pressure tank. Photo courtesy of Moscow News.

Miniature Directional Signal. A foraging bee brings home one drop of nectar. His fellow workers sniff it like bloodhounds, and from the scent know just where to go for more. This tiny droplet is nature's miracle for keeping bees on the beam.

Miniature Selector Switch. Missiles stay on course when controlled by complex selector switch. Two MPB bearings on its shaft make frictional torque practically negligible, keep total weight down to .42 ounce. It's a man-miracle in miniaturization.

Man With Miracles. This is Hank Eckert, one of MPB's Sales Engineers. He helped the selector switch people find exactly the right type of MPB radial retainer bearing to hold friction to a minimum, give dependable service and assure operating precision.

Designers' dream world Miracles in Miniaturization

BEARING ACTUAL SIZE

New Miracles. Today's industrial scientists are pioneering a whole new world of man-made miniaturization. With MPB miniature bearings and experience it is a wide, wide world on a tiny scale. For in miniaturization, bearings are one of the most critical considerations.

MPB makes miniature bearings 3/16" O.D. down (specials on request). In stock—over 500 types and sizes. Consult MPB when you are embarking on a miniaturization problem and/or write for new MPB catalog. **Miniature Precision Bearings, Inc.,** 207 Precision Park, Keene, N. H.

MPB

Helps you perform miracles in miniaturization

or gravel, badly rutted, so our low-slung cars couldn't navigate most. But Soviet buses, trucks and cars do, to bring tourists to shrines. In the villages, the houses are all built of logs, older ones sagging, but there is ornamental scrollwork at the eaves and around the windows and each sports two or three TV antennas (and as many families) where power is available. Where it isn't, they have thermo-electric gadgets to go around an oil lamp to generate power for a small radio.

Women still wash clothes at stream edges. They get water at the hand pump (or pressure spigot) at the street corner, but it is carried home in drawn-aluminum pails and buckets. Kvass (a drink made of fermented rye bread) is sold from modern pressure tanks on wheels at key corners. Stands dispense flavored mineral water, ice cream in cups, bars, sticks, sausage or cheese in a bun, even candy, oranges and apples. The water stands have CO_2 tanks for carbonation and a pressure spray to clean glasses, yet the whole business can be hauled by hand—and a drink costs only a US nickel.

One Sunday, we drove out to the monastery of Zhagorsk, 95 km from Moscow. I suggested that, on the way back, we go to Abramtsevo, the country home of a novelist of 75 years ago. The driver and interpreter fell in with the idea. As we bumped over the cobbled and rutted side road, he made a remark that set the interpreter into gales of laughter. She finally interpreted for me. It was: "Today we are slaying two hares with one rock." So "two birds with one stone" has a Russian equivalent. My lunch that day, incidentally, packed at the hotel, was two caviar sandwiches, three new tomatoes, and 10 apples.

MANNERS IN PUBLIC AND PRIVATE

Somehow, people get to remote estates, poet's hide-aways, writer's birthplaces, to see the sights. They come in droves and dutifully don felt overslippers to protect the parquet floors as they shuffle along. They don't deface walls, or pick flowers, or break down shrubs, they clean up where they've picnicked, they don't disturb scientific or recording equipment that may be around.

In Moscow, I went to the 103,000-seat Lenin Stadium to see the Russo-English soccer game. So did 105,000 Russians. They were like Americans at a ball park—except that they *whistled at* (booed, in effect) *their own team* at the end to show their displeasure at a poor performance. (It was a 1-1 tie, but the British lost the breaks.) And there were fewer than 300 cars in the parking lot—people came by bus, Metro, or afoot.

One night, I walked the length of Moscow and was accosted only by one young man—who wanted a light for his cigarette. Nobody watched me that I could tell, although I was accompanied most days and most visits by my interpreter, a 23-year-old girl recently graduated from the Language Institute after five years of training. Nobody stopped me from taking pictures anywhere (except from airplanes and in one auto plant), and the baggage check when I left was perfunctory. Thus it would appear that "unchanging Russia" has come a long way from the early days of Communism, when everything was prohibited or regimented.

I sent postcards saying exactly what I thought; they have not been stopped. I talked freely with many people, made many notes in all sorts of places. Nobody stared at me more than I stared at him. In the early days, nobody helped me, but nobody hindered me, and in the end they loaded me with data and many of the pictures reproduced here.

The people were courteous, friendly, fun-loving; they didn't short-change me as often as some other Europeans did. Most of them didn't accept tips, except where they've been "spoiled" by tourists. They love to barter and bargain—but the cable operator one night accepted and sent a cable even though I was a ruble or more short. Another girl gave me Kopeck pieces for my coin collection. My interpreter insisted on paying for lime soda or mineral water when we had it, as well as for the Metro or entrance fees for which she was reimbursed. And, just before I left, the engineer to whom I was already deeply indebted for setting up my visits to plants brought to my hotel two books on Moscow pictures with English legends, and a 4-record LP of "Eugene Onegin," one of the greatest Russian operas, for me to take to my family so they would "be compensated a little for not having been able to see Moscow with you."

One American woman in the Embassy explained that as soon as she ate up her 4500 lb of canned goods, she was going home. Another has for years carried a necklace to be put around the throat of the Christmas suckling pig (which she couldn't get in New York). She told her Russian cook all about the pig, roast apple in mouth, and all the rest of it. When the cook served the pig to the assembled guests, the necklace was in place, but the cook had the apple in her own mouth. Sometimes gestures don't help either.

Sputnik III orbited the night I landed in a TU-104 jet transport (72 passengers, 800-100 kmph (500 to 600 mph)), but nobody ever reminded me that it was bigger than anything we'd been able to put up or that they'd beaten us in the satellite race. After all, we are the country that has everything, that is first in so many things. And we are so cocky about our achievements that we invite derisive comments when we lose. But Russians admire us tremendously for those same accomplishments and have set us up as the obvious target in the race for technological superiority. They know they won in sputniks, but there are so many other things. . .

Engineers discussed their achievements proudly, but admitted their shortcomings and weaknesses compared with our accomplishments. They congratulated me because we had produced Cliburn, Stokowsky, Ormandy (then touring the USSR). I heard the same thing in recorded interviews in English with these celebrities on Radio Moscow—between broadcasts of obvious propaganda against our attitudes.

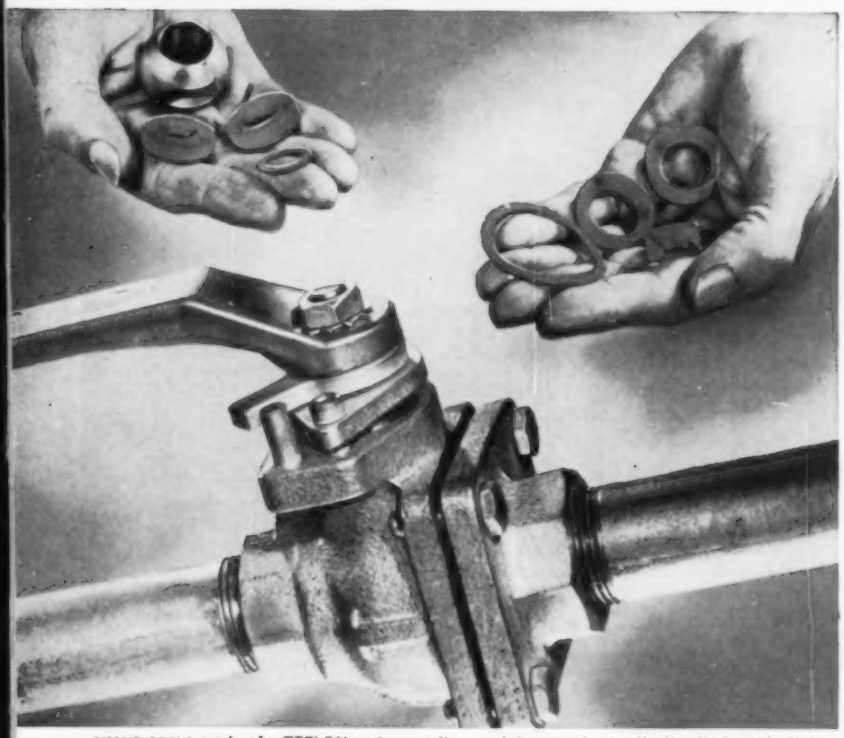
Strangest paradox of all—I saw recruits going and coming from daily training, but I saw no tanks, guns, fighting planes, no posters or haranguers against the West. And there was no mention of things military on my visits and no exhibits of things military anywhere I visited. ■

DU PONT

Better things for better living . . . through Chemistry

PRODUCT ENGINEERING NEWS

LATEST PROPERTY AND APPLICATION DATA ON **TEFLON®** tetrafluoroethylene resins



VALVE SEALS made of a TEFLON resin permit easy opening or closing of ball valve under any pressure. Due to use of a TEFLON resin, no oil or grease is needed for lubrication, and maintenance is practically eliminated. (Valve by Rockwood Sprinkler Company, Worcester, Massachusetts.)

Seals of TEFLON® tetrafluoroethylene resins eliminate lubrication . . . cut maintenance

Designing a ball valve which needs no lubrication was made possible by utilizing seals molded from a TEFLON tetrafluoroethylene resin. Designing with TEFLON resins also allows minimum maintenance of the valve, since the seals are tough and durable and resistant to any chemical or corrosive that can be handled by the valve's stainless steel body. The extremely low coefficient of friction of TEFLON resins makes the valve quick-operating with no tendency to stick. Its design, with the ball forced against a seal of the resin by spring pressure, assures a drip-tight closure even at low pressures.

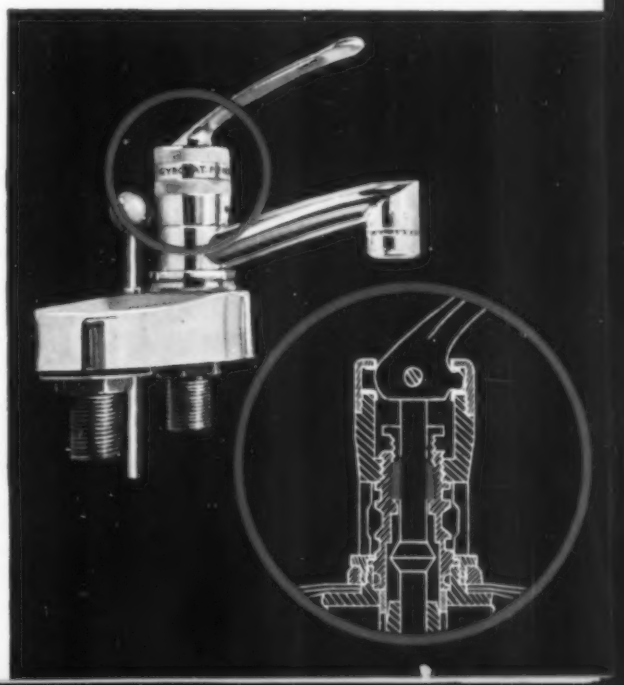
TEFLON resins are rated for use at temperatures to 500°F. Chemically, they are among the most inert materials known to science. Parts made of TEFLON resins are tough and durable. So outstanding are these resins as sealing and gasketing materials, that their use is often specified even where their exceptional heat- and chemical-resistance are not required. In particular, TEFLON resins are used for *extra safety* and *reliability*.

Packing gland of TEFLON® tetrafluoroethylene resins improves assembly and performance of new mixing faucet

A packing made of a TEFLON resin permits smooth rotation and easy up-and-down motion, yet prevents any seepage of water through the stem of this faucet. It can be assembled into the valve very easily, quickly and efficiently, and the adjustment on the packing can be uniformly pre-set by machine. This increases production, saves money in assembly and virtually eliminates packing replacements in the field. (Faucet by Gyro Brass Mfg. Corp., Westbury, L. I., N.Y.; parts molded of TEFLON tetrafluoroethylene resins by Sparta Mfg. Co., Dover, Ohio.)

WRITE FOR DETAILS on how to use Du Pont TEFLON tetrafluoroethylene resins in your own designs; E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Dept., Room 367, Du Pont Bldg., Wilmington, Del.

In Canada: Du Pont Company of Canada (1956) Limited, P.O. Box 660, Montreal, Quebec.

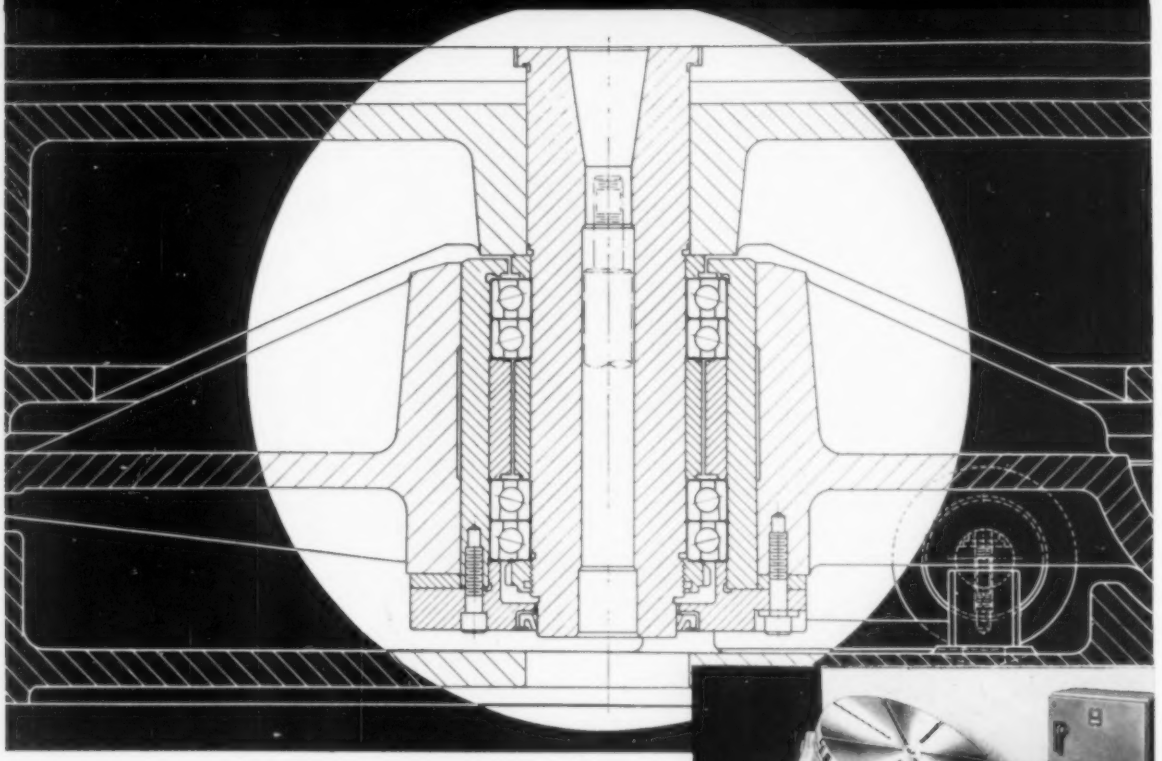


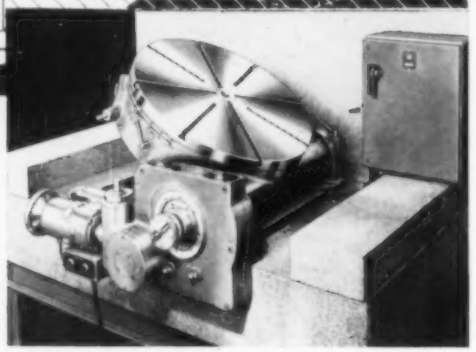
TEFLON® *is a registered trademark*

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the tetrafluoroethylene resins discussed herein. This registered trademark should not be used as an adjective to describe any product, nor should it be used in whole, or in part, as a trademark for a product of another concern.

Watch the "Du Pont Show of the month"—90 minutes of the very best in live television—CBS network

1½-ton rotary table held accurate to seconds of arc!





PRATT & WHITNEY
equips for precision with
FAFNIR BALL BEARINGS

The extreme accuracy designed into Pratt & Whitney's 36" Tilting Rotary Table puts a heavy premium on bearing performance. For the critical central pivot application, Fafnir super-precision ball bearings are specified.

Here are bearings with the capacity and rigidity to hold a ton-and-a-half table at *seconds of arc* accuracy — and maintain this precision under large-job work loads.

It takes plenty of bearing to deliver performance like that! Yet the application is typical of many in Fafnir's files. Fafnir's "experience in precision" can help *you* solve a bearing problem. Write The Fafnir Bearing Company, New Britain, Connecticut.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

Pratt & Whitney 36" Precision Tilting Rotary Table is designed for large jobs requiring precise circular spacing and angular positioning. It is completely powered . . . makes possible several machining or inspection operations with a single setup . . . permits direct rotary vernier readings to two seconds of arc over a 360° range and tilting vernier readings to one minute of arc over a 90° range, with a sine bar arrangement for setting table tilt accurately to seconds.

Fafnir Super-Precision Ball Bearings, counterbore construction, support the central pivot of the table component in Pratt & Whitney's 36" Tilting Rotary Table. Mounted in tandem duplex pairs, they provide the exceptional rigidity necessary for this precision application.

HOW NEW INDUSTRIAL EQUIPMENT IS DEVELOPED

Major present USSR objective is to expand industry. Heart of the necessary equipment design, research and development are the design institutes, one for machine tools, another for cutting tools, another for coal-mining machinery, another for steel projects (blast furnaces and rolling mills), and so on. These were initially designing adjuncts of appropriate ministries. Decentralization over the past two years has abolished the ministries, but the institutes remain. As might be expected, their size, efficiency and effectiveness all vary with the industry, the personnel, the state of the art, and the availability of foreign equipment to buy or designs to copy. They do the research difficult for individual plants and have other functions perhaps best explained by describing the work and results of a typical one which I visited.

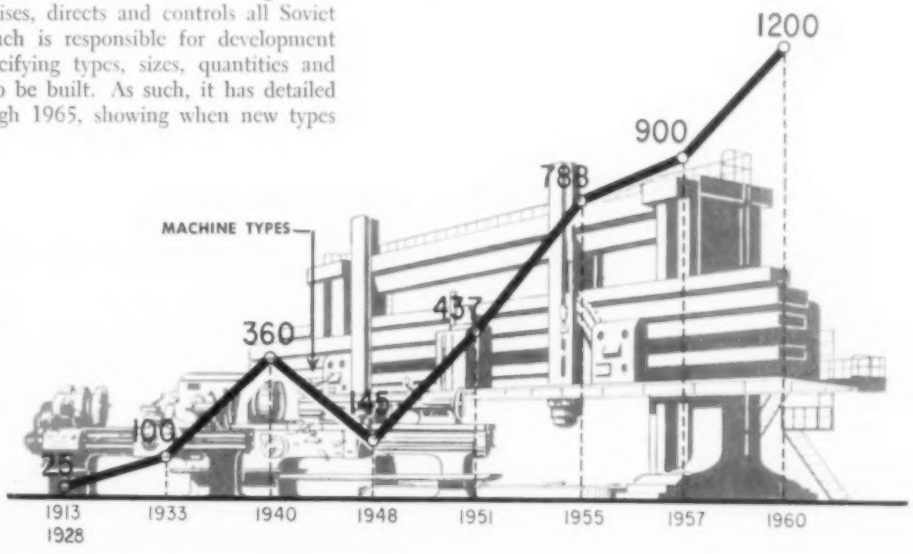
Generally considered to be one of the best institutes is ENIMS—initials of the Russian words for "Experimental Scientific Institute for Machine Tools." It is also a bellwether, because machine tools must be made first and well—or the other products cannot be. ENIMS employs 1,000 people, is just over 25 years old, and supervises the design work of the 8,000 people involved in machine-tool design in the USSR, including people in specialty bureaus (milling machines, lathes, etc.) as well as in the design bureaus of the machine-tool plants themselves. ENIMS is an arm of the Central Planning Commission, which supervises, directs and controls all Soviet production, and as such is responsible for development of a master plan specifying types, sizes, quantities and designs of machines to be built. As such, it has detailed plans extending through 1965, showing when new types or sizes are to be designed, when built, and in what quantities. It is also the basic source of new designs and the testing laboratory for all Russian machine-tool factories, as well as the research center for projects too broad or difficult for the individual plants. Here are its four divisions:

1. **Checking and Testing.** All general designs for machine tools produced in the USSR must be checked and approved here before manufacture. Also, all components (electrical, hydraulic, etc.) produced by other institutes and suggested for machine-tool use are tested and approved here. The bureaus for the design of new standard and transfer machines are in this division.

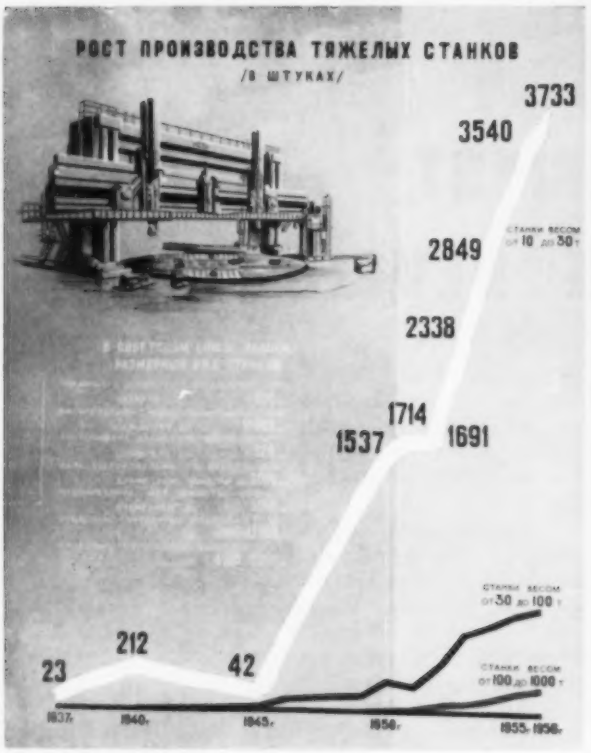
2. **Engineering Research.** Here are made scientific studies of wear, rigidity, vibration, plastic deformation of gears, and similar problems. Much of the supervision is by experts recruited for specific assignments. Results of these studies are published and sent to special design offices and to factory design bureaus.

3. **Technology of Production Methods.** Proper method of machining particular shapes or materials and like problems are attacked here. The emphasis and approach are scientific, not empirical. Specific problems in methods submitted by factories are also worked out.

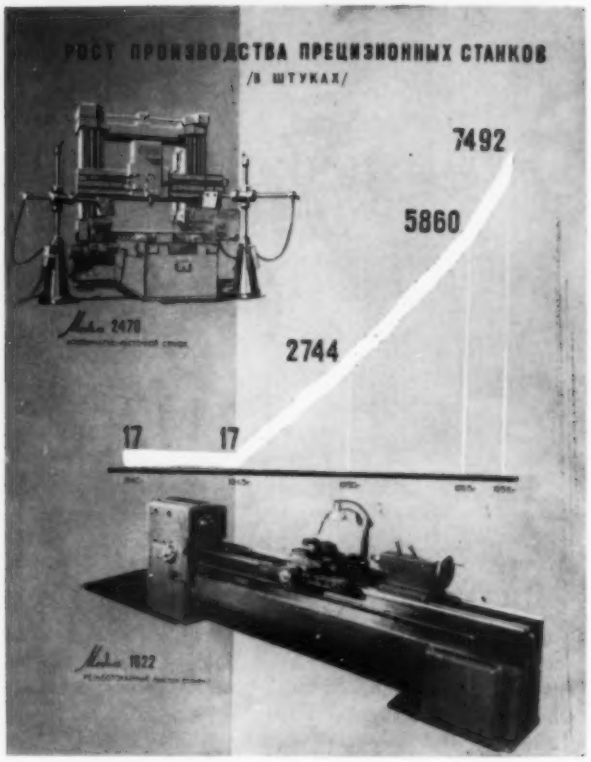
4. **Experimental Plant.** A separate plant, but operated



BOTH TYPES and numbers of Soviet-produced machine tools are rising rapidly. The curve shows standard machine types produced. (The decline in 1948 is the result of World War II destruction). Units produced in 1928 were 1490, in 1957 almost 100 times that: 130,000. Projected for 1960 are 150,000 standard units.



NUMBER OF HEAVY MACHINE TOOLS produced has risen rapidly since World War II—has jumped almost 100 times in 10 years in the case of 10- to 30-ton machines. Lower curves show increases for 30- to 100-ton and 100- to 1000-ton machines.



PRECISION MACHINE TOOLS were the bugbear of Soviet production. But, since 1945, the number has increased over 400 times. At the current rate of increase they will produce almost 8600 precision machine tools in 1960.

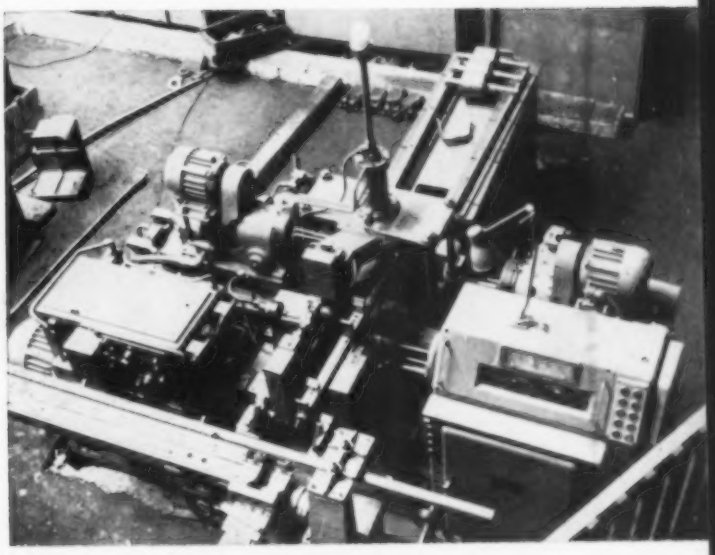
by the director of ENIMS. New machine-tool prototypes are made here, models tried out, designs and drawings corrected or approved. This work occupies about 50% of plant time; the rest is taken up by building balancing machines and gear-cutting machinery (see photos) not made in the regular production factories. Designs for machine tools other than these, however, are sent to particular plants for quantity production.

SOME TYPICAL PROJECTS

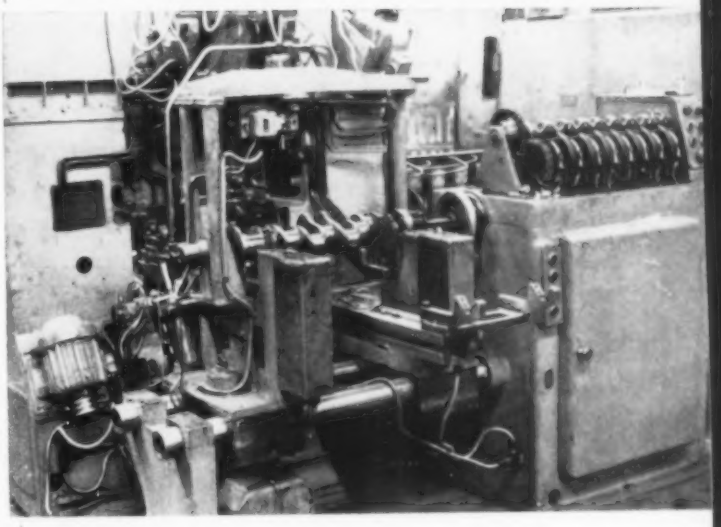
ENIMS has done many interesting design jobs through the years. During the years 1933 to 1947, for example, ENIMS was the sole developer and maker of unit-head machines. It also produced the first transfer line (cylinder blocks) in 1946, has been the major factor in development of automatic machine tools. It designed and built the automatic piston line that occasioned so much comment three years ago, as well as the ball-bearing line publicized last year. It is now emphasizing flexibility in automated lines, has recently produced a gear line and a shaft line embodying this desirable characteristic. It also attempts to design new units so they will work either singly or in a transfer line. It produced nine machine tools for exhibit at the Brussels Fair, three of them program types (two copy millers, one lathe). Its latest line, for splined shafts, has been set up at the 1958 Industrial Exhibition in Moscow.

So many kinds of design, development and research work are done at this Institute that it is difficult to mention all of them. It tests Soviet machine tools against available foreign tools for the same job. Special electronics, hydraulics, and power labs test components and evaluate them for use in machines. Standards for machine tools are worked out, parts and complete designs standardized (In the Soviet Union, most production is of standard items in quantity, from components to complete units. Thus the standard machine tool incorporates standard bearings, gears, switches, and so on). Stepless speed variation is a current must, particularly for lathe drives, so is being worked on intensively. Other research projects include electrical-discharge machining, air bearings, carburizing with a high-frequency coil (which cuts an 8-hr cycle to a 1-hr one), press-forming of gears, vibration in a lathe.

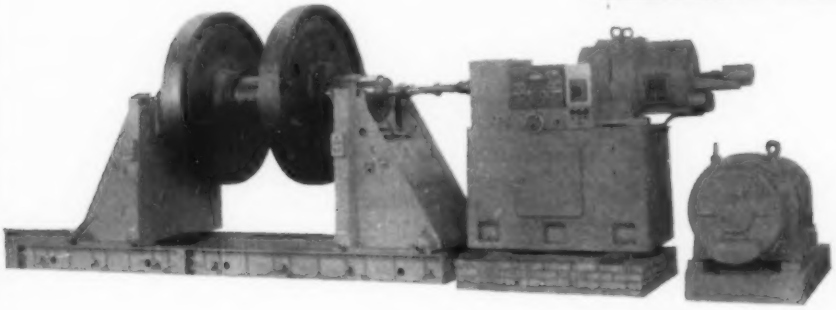
At ENIMS, average time from idea or plan to finished drawings of a new machine tool is eight to nine months, a year or even longer for a new transfer line involving machine units not currently available. The automatic piston plant took four years from design to production—two of them for debugging.

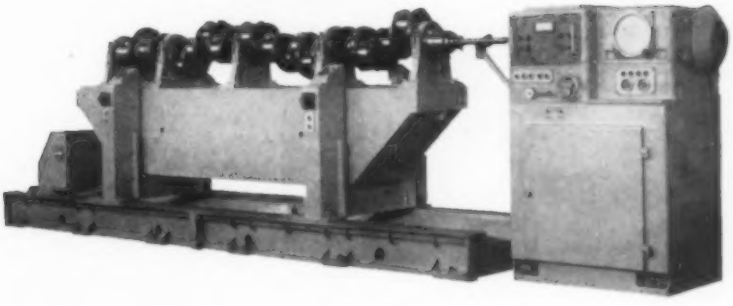


WE DISCOVERED the tap disintegrator, but the USSR went on to electrical-discharge machining, now has thousands of well-designed machines like this one in use. A recent discovery substitutes a graphite tool for the conventional brass one and interrupted, rather than continuous, discharge. This increases rate of metal removal 10 times—from 400 or 500 to 5000 cu mm/min, but produces a rough finish. Final finishing is then done at conventional rates with conventional tooling.

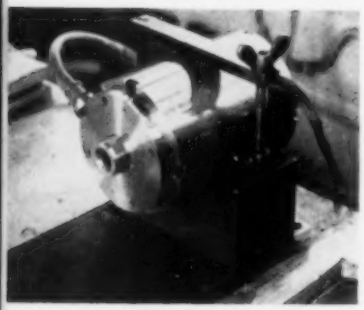


AUTOMATIC BALANCING MACHINES for transfer lines are still a tough problem, so ENIMS makes designs, also makes larger machines. Here are four standard models, the top one for motor rotors, the second for automotive truck crankshafts (unfinished), a 16-ton unit (made in sizes from 10-kg to 75-ton by ENIMS, smaller elsewhere) for wheels, etc, and the fourth for crankshafts 3 m (10 ft) long. The latter machine required addition of steadyrests at central points because the lengthy shaft deflected of its own weight.

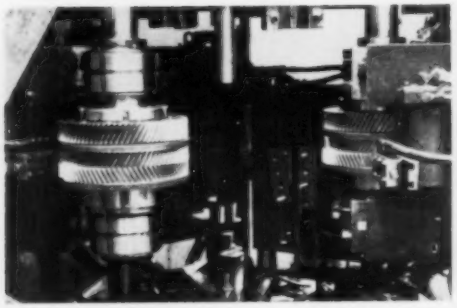


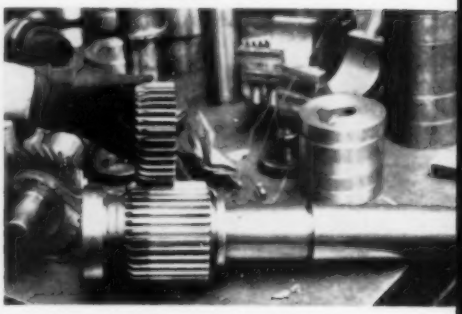


HOW MOSCOW DESIGNS . . . *how new industrial equipment is developed*

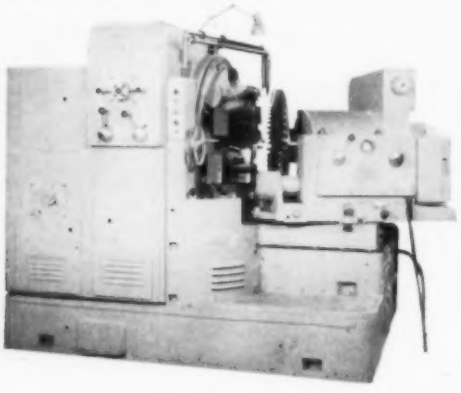


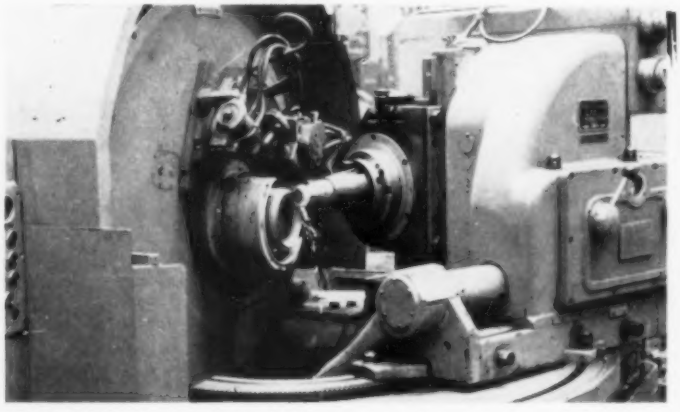
HIGH-PRECISION BALL bearings are a production impossibility in the USSR. So ENIMS is working on an air-pressure bearing for high-frequency motors to run at 50,000 rpm. This research has provided an unexpected dividend—a much more rigid shaft can be put in a bearing of a given size.



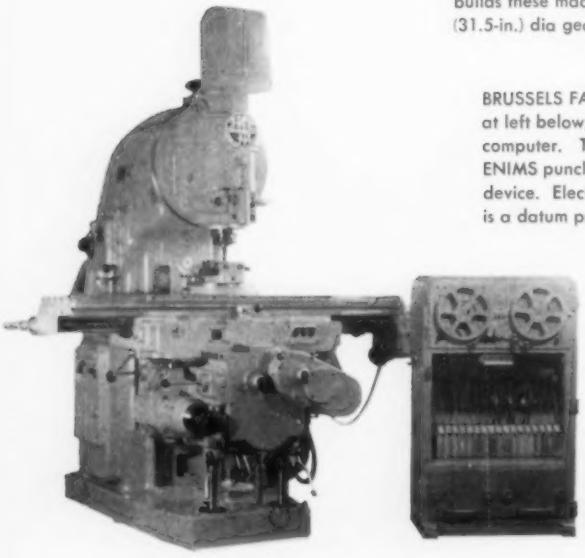


ROLL-FORMING OF GEARS is a current development project. Gears have been made successfully, but they are not accurate enough for machine tools without finish grinding that destroys the forged tooth surface. In rougher machinery, however, they have given excellent wear rates because of the hot-worked tooth surfaces. The cycle is to heat the blank periphery with a high-frequency coil in the machine at left, (coil and work arbor not in place) then rotate it against the rotary tool (or tools) as shown in the closeup at right. Burrs are created on the open face of the gear, but can be removed easily. Thus far only straight spur pinions have been made successfully, but now other tooth shapes and larger diameters are being tried.

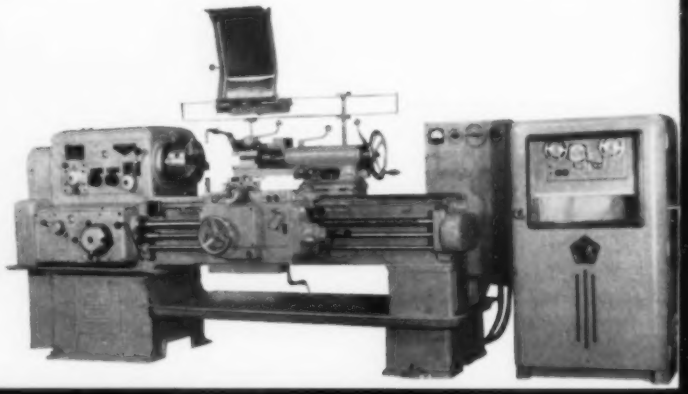


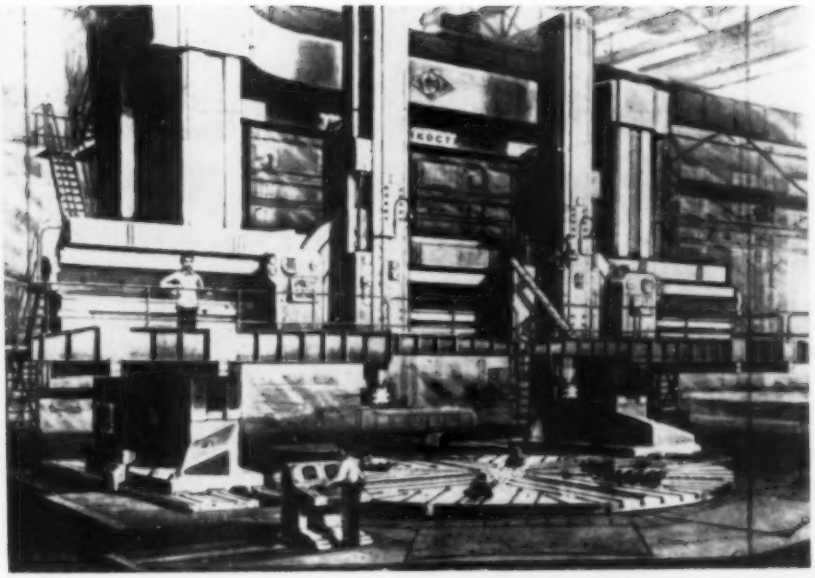


BEVEL-GEAR-MAKING MACHINERY—an area in which we are pre-eminent—is expressly banned as a US export to the USSR. So engineers there developed their own. I saw some early machines developed at Likhachjov Automobile Works and still in use there. Now ENIMS has designed and builds these machines. At left is the largest standard machine, capable of making an 800-mm (31.5-in.) dia gear. At right is the largest spiral-bevel grinder, able to finish the 800-mm gears.



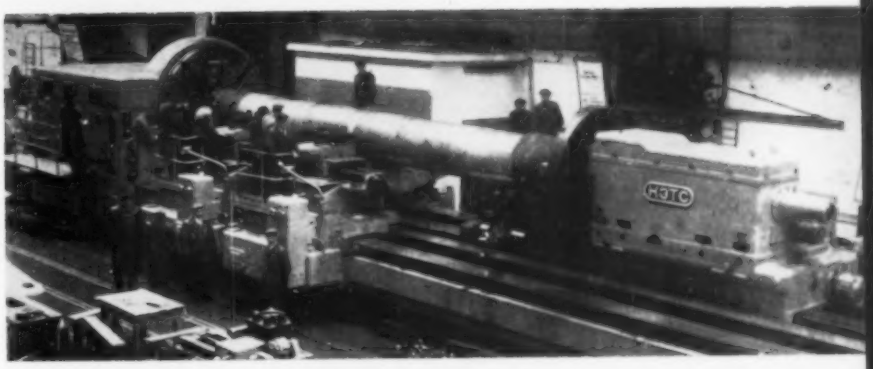
BRUSSELS FAIR exhibits these two program machines. Gorky Works made the standard miller at left below, ENIMS programmed it with a magnetic tape operating a transistorized digital computer. The 400-mm (16-in.) lathe (below) was made by Krasny Proletarii Works, has an ENIMS punched-tape control. Some standard commands can be transferred from tape to a memory device. Electromagnetic clutches handle main-slide movements. A location stop in the tailstock is a datum point for the tool.



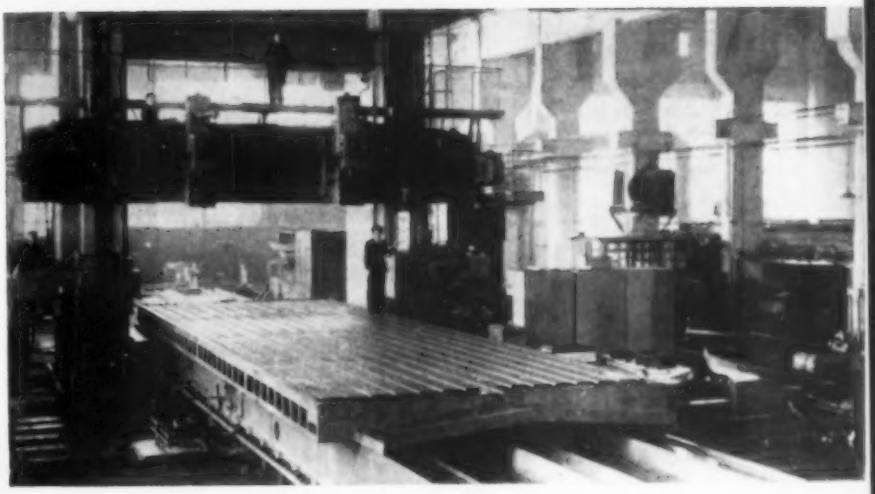


Here are the USSR's Largest Standard Machine Tools

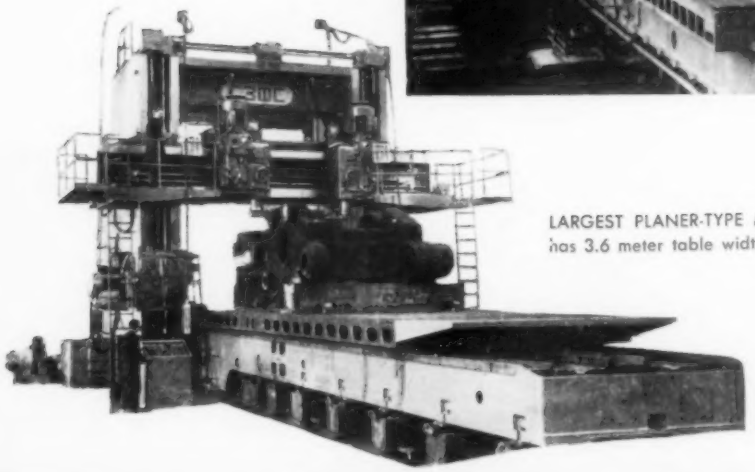
LARGEST BORING MILL is made by the Colomna Machine Tool Works. It will turn a piece of 10,000- to 12,500-mm diameter (33 to 41.5 ft). In design is a larger unit, capable of 16,000-mm (52.5 ft).



LARGEST LATHE is the 4 x 15-meter machine made by Crematorsk (Ukraine) plant, which makes only heavy lathes. This would correspond to 13-ft. swing and 50-ft bed.

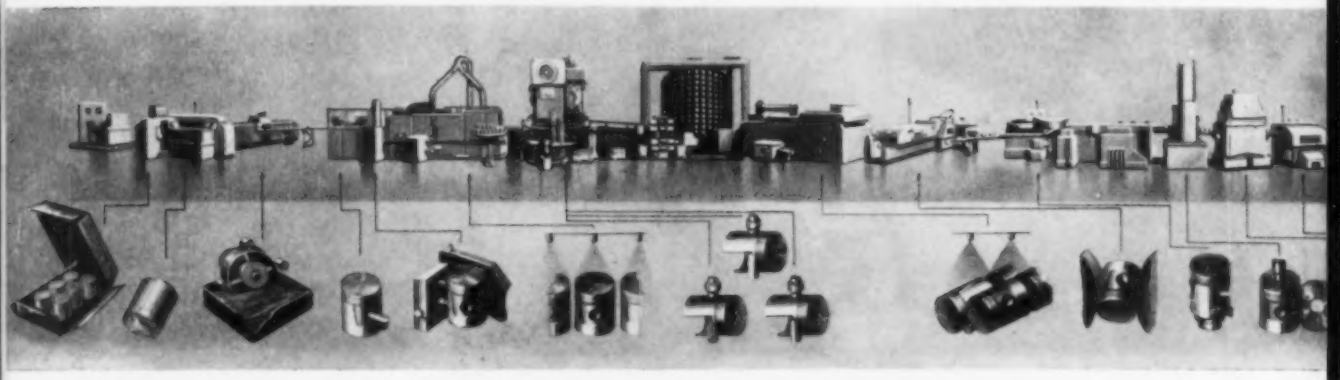


LARGEST STANDARD PLANER is produced at Novosibersk, Siberia. Capacity is 5 x 15 meters (16.4 x 49 ft).



LARGEST PLANER-TYPE MILLER is also made at Novosibersk. It has 3.6 meter table width with 12-meter stroke (11.81 x 39.36 ft).

HOW MOSCOW DESIGNS . . . *how new industrial equipment is developed*

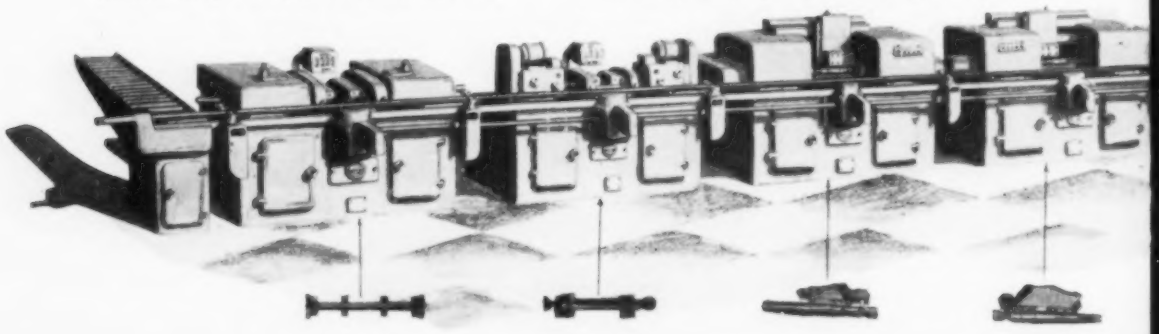


▲ MOST FAMOUS of the lines is this one for making truck pistons from aluminum. It starts at right with aluminum ingots, ends with oiled and wrapped pistons packed six to a carton. Productivity is 8 or 9 sec per piston. This diagrammatic sketch shows both line and operations.

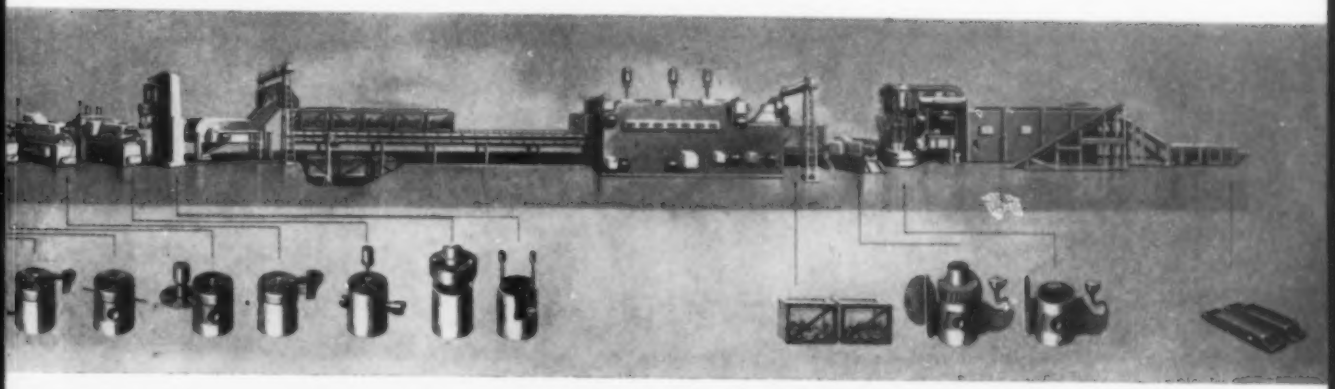
◀ PROGENITOR of all Soviet transfer machines is this 33-position cylinder-block line, installed in the Minsk Tractor Works in 1947. It does all machining of the block, is based on a unit head developed at ENIMS, where the machine itself was built. Various plants (including Likhachjov Automobile Works) have since developed unit heads which they make for use and sale.

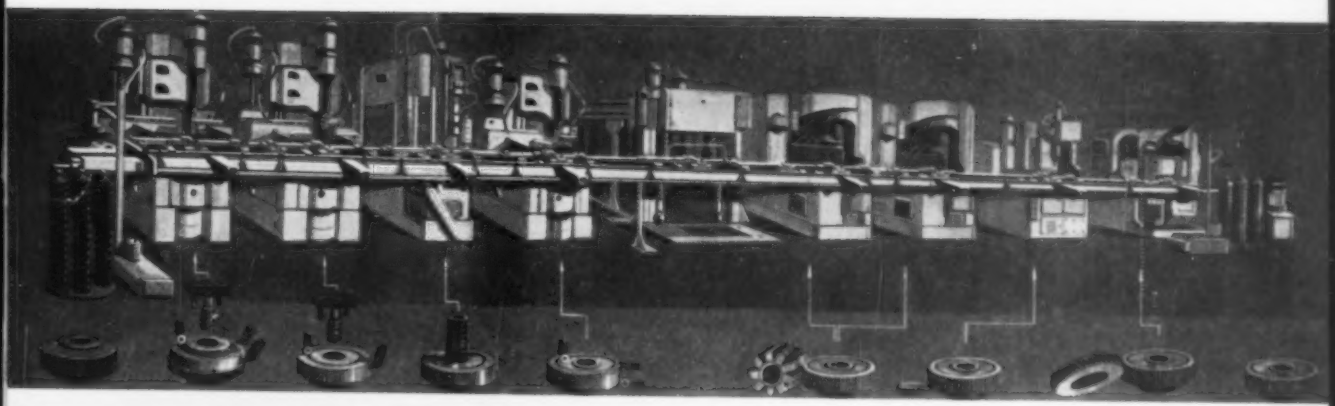
NEWEST OF TRANSFER LINES is for shafts, again incorporating banks and flexibility. The line diagrammed is for motor rotors and includes machining and balancing the rotor after assembly. Units are (starting from left): bank, facing, centering, multi-point turning (2 stations), rough centerless grinding, drive for transfer, knurling, finish centerless grinding, key slotting, bank, pressing on rotor, finishing rotor OD, automatic balancing, bank. A line like this has just been set up in this year's Industrial Exhibition.

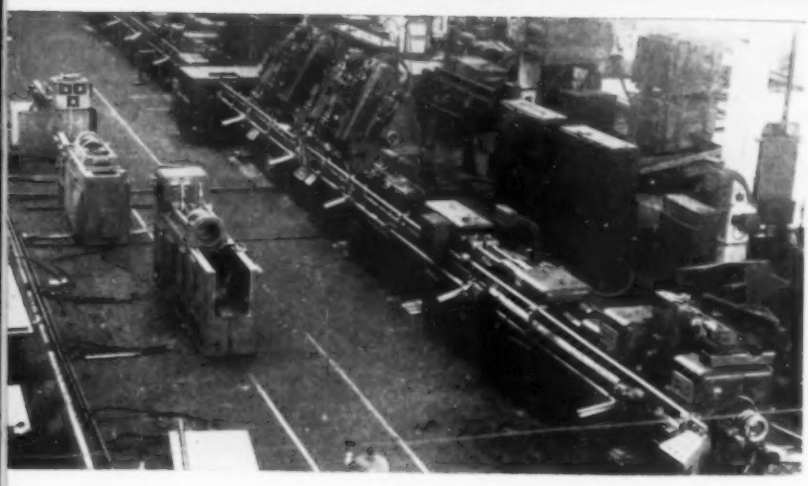
▶ FIRST SHAFT LINE, pictured here, had grinding on center (tall machines). Here are some statistics comparing its performance (1957) with the former method (1954). Annual output upped from 76,800 to 168,100, with labor cut from 24 to 5 men. Output per man per year thus rises from 3200 to 32,000 pieces. Cost price per piece dropped from 6.55 to 2.56 rubles, delivering an annual savings of 744,600 rubles.



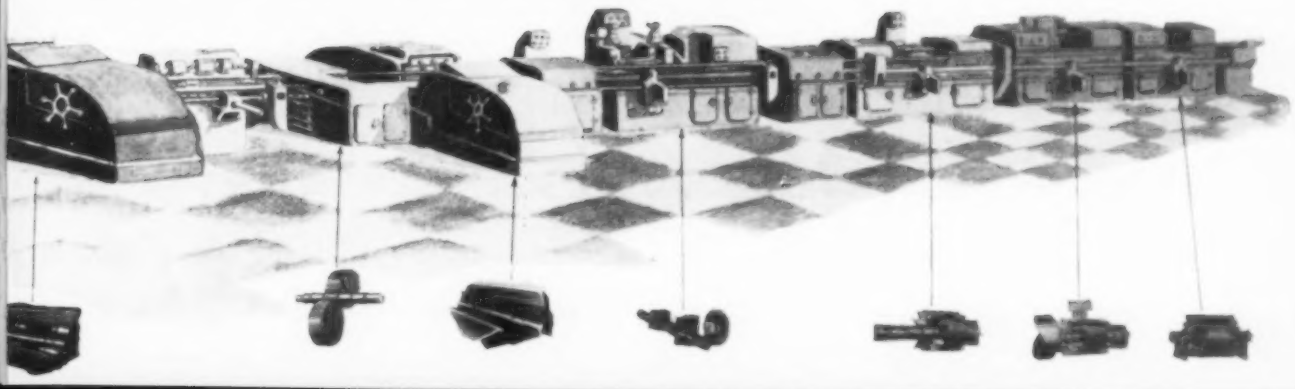
The New Look in Soviet Automatic Transfer Lines

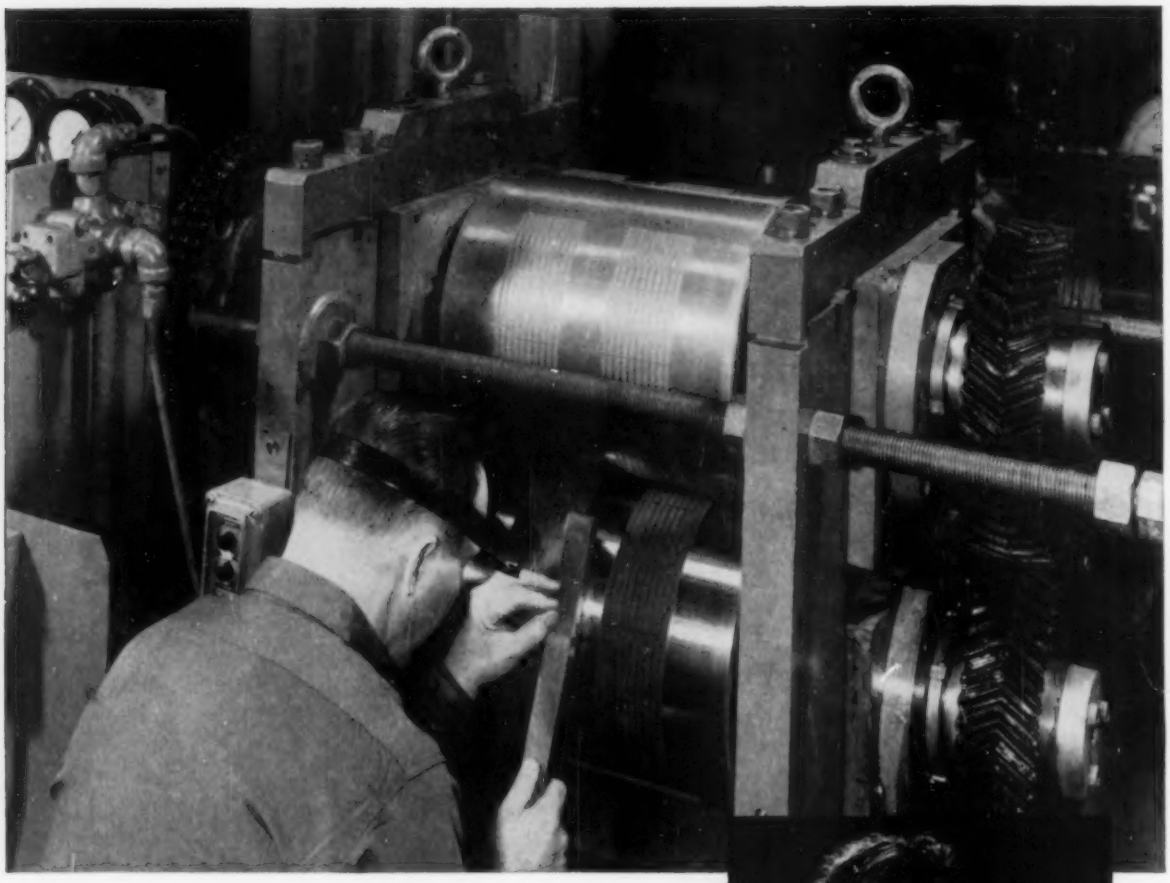






▲ GEARS from 80- to 250-mm dia (3 to 10 in.) and 2 to 6 pitch can be made on this new line, shown diagrammatically with sketches of operations. The start is at left, and all machine units have the same table height, designed that way so they can be used either in a line or individually. Sequence of operations is: rough turn (3 tools) and bore, finish turn (2 tools) and bore, broach bore, chamfer and recess face, store (in a center bank, so either half of the line can be shut down for tool change or maintenance without stopping the other half), hob teeth, chamfer, shave. Note design for flexibility, machine interchange or separate use, servicing without total shutdown. Krasny Proletarii lathe plant in Moscow has the first one. Krasny Proletarii, incidentally, matched total US production of lathes alone in 1956, beat it in 1957.





"Quality perfection is our business —Standard Steel helps us maintain it—and more"

Alclyde Engraving is in a fascinating business. Chances are the dashboard trim, instrument panels, and scuff plates on your car were embossed on Alclyde rolls—this firm manufactures the major part of all rotary register embossing rolls used by the automotive industry.

The packaging, labeling and plastics industries are also heavy users of Standard-forged, Alclyde-engraved rolls. And in all fields in which design changes are a frequent and vital competitive factor, Alclyde must deliver perfection in a hurry.

That's why we at Standard have geared ourselves to give Alclyde the quality perfection and service it requires. In fact, it's the *service* we can give that all of our customers particularly appreciate. Won't you discuss your quality *and* service requirements with us? Write Dept. 4-G.

"Yes, Standard Steel Works, in supplying us with matched, flame-hardened forged steel embossing rolls, meets our rigid specifications for steel analysis and accurate machining. Nothing is more vital to an engraver than to have perfection all along the line. But in addition, we appreciate the warm, personal relationship which exists between us. The people at Standard appear to be really interested in our business and problems," says Frank W. Broderick, president Alclyde Engraving Co., Chatham, N. J.

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BURNHAM, PENNSYLVANIA Rings • Shafts • Car wheels • Gear blanks • Flanges • Special shapes

THE SOVIET UNION NOW HAS 105 ECONOMIC REGIONS

In decentralizing the huge Soviet Union in accordance with radical—almost capitalistic—suggestions of Premier Khrushchev, the 15 republics were broken down into 105 economic regions, each governed by its own economic council. As shown in this map, new to the US as far as we are aware, regions intentionally cut across the traditional subdivisions, vary in size with economic potential. Moscow city is Region 1, the area immediately around it Region 2, and so on.

Prices? Selling? Redesign? Service?

How are product prices set? Who replaces the salesman? How are goods sold? What about service, maintenance? Who handles redesign, and when?

These are all questions the American asks when he realizes that everything in the USSR is owned by the people and there is no competition in our sense.

It is important to understand initially that the USSR is far from realization of its full industrial potential. There is great demand and need for any capital goods produced. The problem is to decide what to do first. Emphasis in such a case is on the most necessary items, and on the priority scheduling of everything well ahead to provide needed equipment to meet future plans.

Consider machine tools as a case in point. The Ministry of Tools has been abolished and control of machine-tool plants in each of the 105 regions (see chart) turned over to the newly created regional economic council in that region, with general control by the over-all Central Planning Commission. This decentralization is only about six months old, so many details have not yet been worked out. Shortages develop periodically, but these are expected to diminish as production rises.

Machines are developed to meet the master plan laid out currently through 1965. The plan is the work of the Machine Tool Institute (ENIMS) in Moscow, checked and approved by Central Planning Commission. ENIMS designs and makes prototypes of new machine tools, but

(continued on page 22)

This sturdy bilge pump, made of GREX high density polyethylene, is so light it floats . . . yet so strong it is virtually unbreakable. Because GREX is corrosion-resistant, it is equally safe with salt water, oils, and greases as well as acids, caustics, solvents and other chemicals.

These facts have great importance to all users of plastics. GREX means new utility in tubing and extruded products, new versatility in moldings, new durability in housewares and sports equipment. Just as it is resistant to chemicals, GREX is unharmed by freezing temperatures or boiling water . . . a quality much appreciated by hospitals as well as housewives.

Equally significant, this new material can be molded into intricate close tolerance shapes. Surfaces have a deep, glossy beauty or soft, matte finish, both with eye-catching color. GREX is versatile . . . adaptable to innumerable applications.

This remarkable plastic means better products for you.

**Trademark for W. R. Grace & Co.'s polyolefins. W. R. Grace & Co. produces GREX resin for a wide variety of uses, does not make the finished articles mentioned above.*

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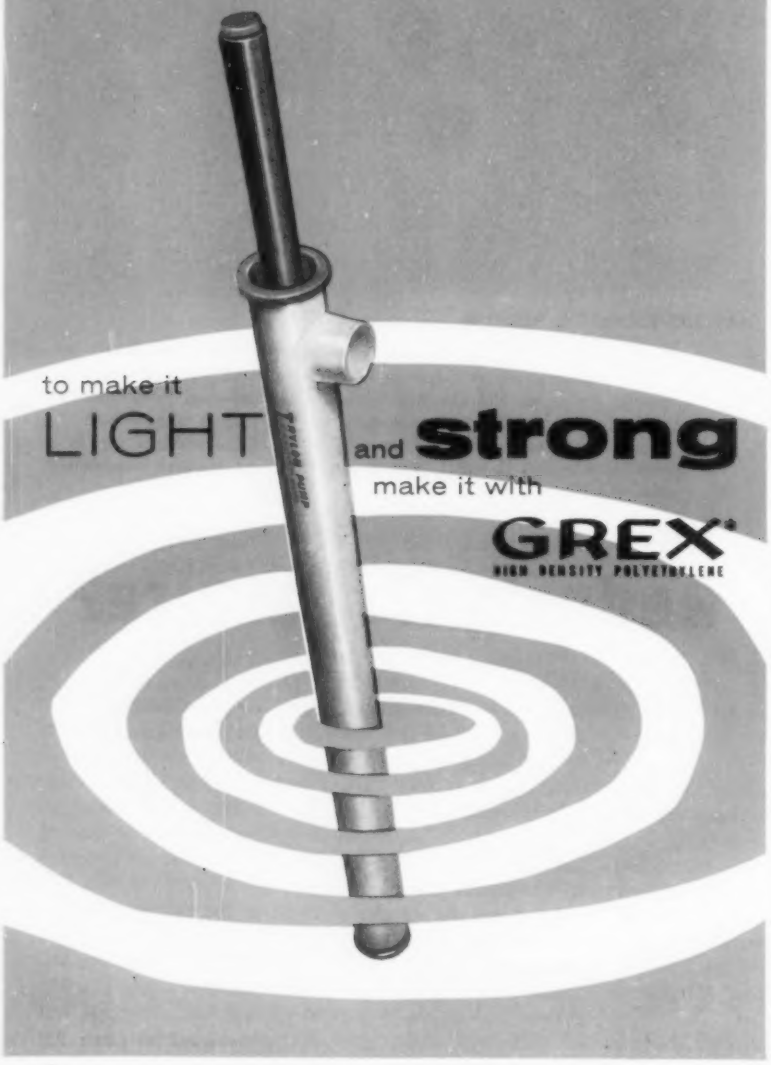


PRICES? SELLING?

(continued from page 21)

design bureaus at the producing plant do the redesign and modernizing unless it involves a change of technology. ENIMS engineers go to plants to help with these problems, follow the progress of redesign and production of their original designs.

Some Western observers seem to see something sinister in Soviet offers to sell machine tools in Western Europe—and even in the US—while at the same time orders are being placed for tools. The impression seems to be that the USSR wants to pass off some of its own tools and buy some better ones. The facts, I suspect, are far more simple. Offered for sale are tools made in quantity in the USSR, hence saleable at attractive prices. Sought for purchase are types which are not thus far in Soviet volume production, hence represent a saving in time and cost. (They may, of course, also represent a chance to get well-engineered prototypes for test and copying.)

Prices for products sold in the USSR are set by the Central Planning Commission, which has engineers to analyze costs and suggest ways to reduce them. The individual plant cannot change prices, but it can go to its regional economic council with facts and figures and the request to protest the set price. This council has its own engineers who study the costs and make a recommendation. When a price protest is made, the Planning Commission usually arrives at a more equitable price by agreement with the regional body. The Commission really suggests and coordinates as much as it controls.

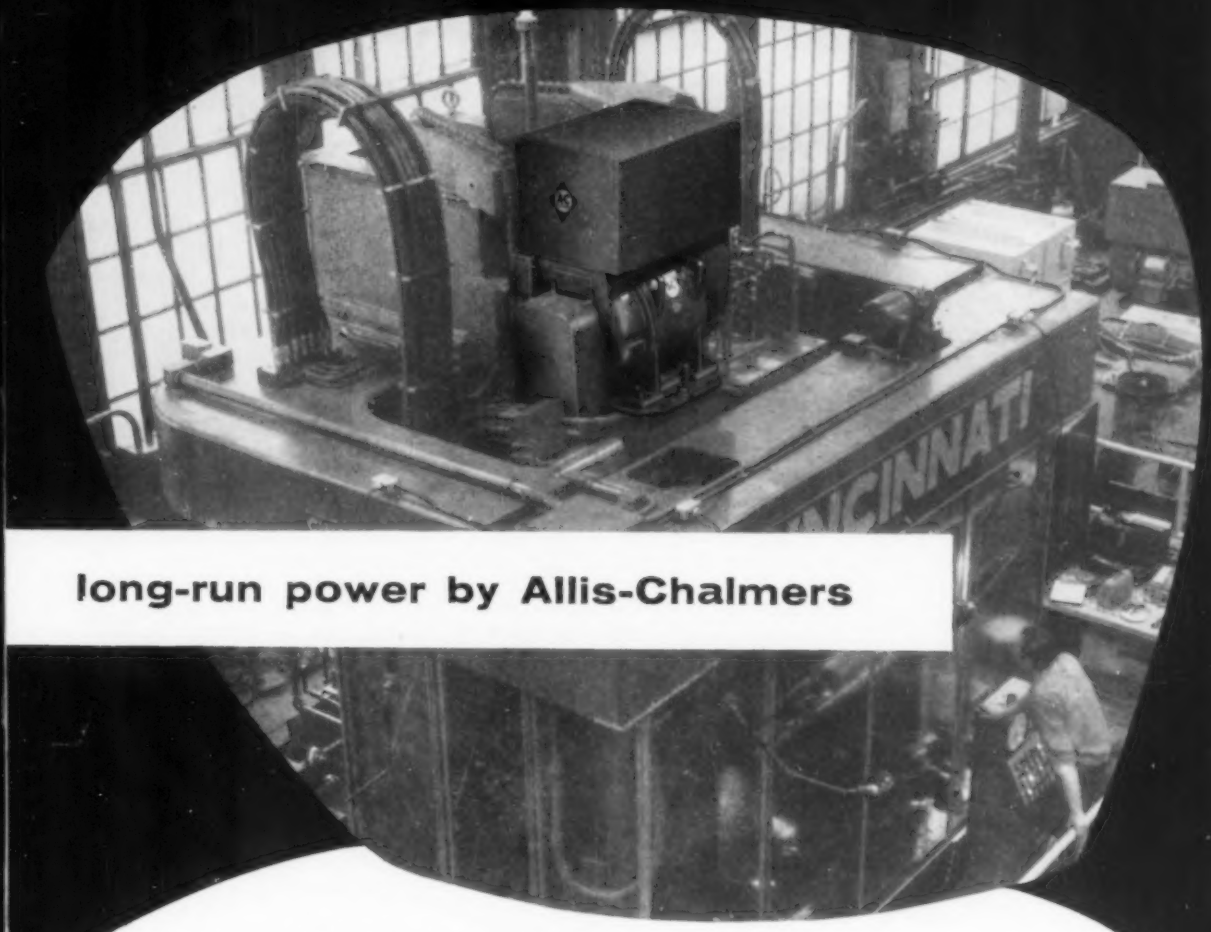
The Commission also sponsors development by direct subsidy. For example, ENIMS built the first automatic transfer line for gears at a cost of 2-million rubles. Krasny Proletarii, which was to get the line, had too

(continued on page 24)

Automation was the subject of a big Moscow conference May 12. Among reports: Output of control devices and automation equipment in 1959 will be 10 times that of 1955. By 1965, output will be five times the present level. Particular emphasis is being put on automating iron and steel, mining and food industries.

CIRCLE 57 READER SERVICE CARD

CIRCLE 58 READER SERVICE CARD →



long-run power by Allis-Chalmers

Even the worst atmospheres can't hurt NEW self-cooled dc motors

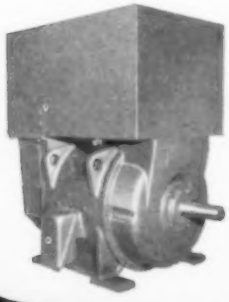
Oil concentrations, dirt, moisture, fly ash, all types of dust — none can affect the long-run power of these new totally-enclosed, self-cooled dc motors from Allis-Chalmers.

For machine tools, steel mill drives, paper mills, cement and rubber plants, these motors are ideal. Here's why:

- Volume of cooling air is *not* affected by motor speed. Outside air is drawn into heat exchanger unit by blower and circulated over the frame. Hot motor air is removed by the exchanger.
- Filters sift impurities from outside air as it enters the heat exchanger.
- Self-contained heat exchanger unit may be quickly removed for maintenance. Further, dc brushes and commutator are also readily accessible.
- Motor-heat exchanger combination is so constructed as to allow top, sidewall or ceiling mounting.

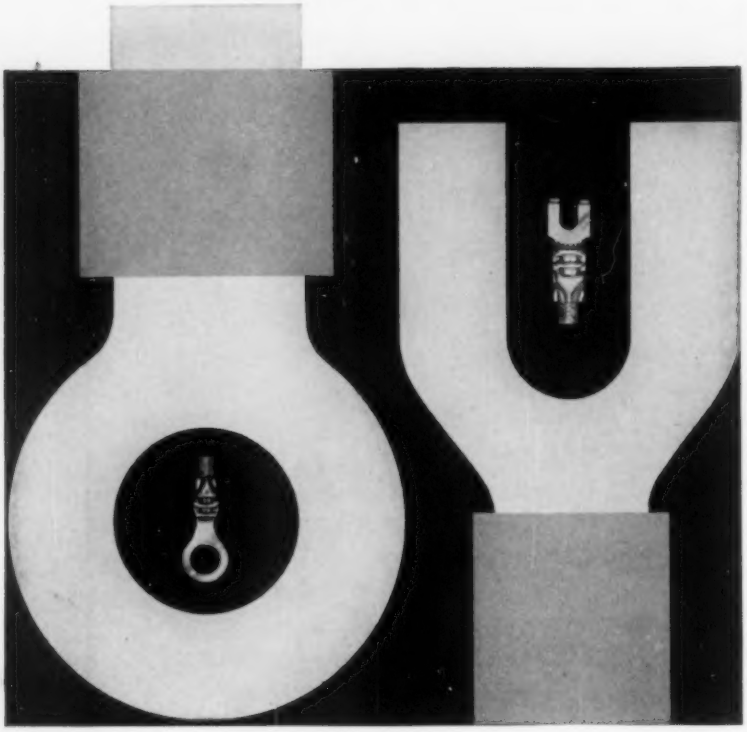
COMPLETE LINE of new dc motors is available from 10 hp to 400 rpm through 200 hp. They are backed by same nationwide engineering service that stands behind all types of Allis-Chalmers motors from 1 hp up.

See your A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



ALLIS-CHALMERS

A-5721



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faster . . . specify the AMP®

PRE-INSULATED DIAMOND GRIP terminal

If you need terminals with bonded insulation—if you need corrosion resistance and wire-supporting vibration resistance—you have it instantly in one closure of A-MP's matched crimping tool. Only one lightning-quick step for crimp-sure optimum strength and conductivity. A-MP PRE-INSULATED DIAMOND GRIP Terminals exceed the most rigid military and commercial specifications.

A-MP's precision-engineered terminals are matched to precision-engineered tools that make an exact crimp every time, never too little, never too much. Perfect terminations—whether you need one or a million. No great operating skill necessary. A-MP's match-mated tooling does all the work and at lower installed cost than other methods of wire termination. Wire range is from No. 26 to No. 10.

To solve your wire-end problems, we maintain an international engineering service.

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PRICES? SELLING?

(continued from page 22)

small a budget for this, so the Planning Commission absorbed something like 750,000 rubles of cost. Copies of the line will be made at Minsk, will sell for 1-million rubles.

The real sales device (except for special machines) is an annual catalog, picturing and describing machines. This is circulated to all potential users, and inquiries rise from it. Service and maintenance instructions are provided in a bulletin, sent with a machine. In the Soviet Union, it is obligatory for the using plant to follow these instructions to the letter.

Setting production quotas by weight or length has had some undesirable effects. The steel mill tends to pour standard carbon steel rather than alloys because this permits higher tonnages, and to roll heavier sections for the same reason. Or so complains one letter to *Pravda*. The ZIS 150 truck (1½ ton) is like the '54 *Studebaker*, but half again as heavy for the same capacity. Some of this is to compensate for the rougher driving conditions, but some is just overweight parts. Textile plants skimp on cloth width—cut the standard 100 cm (39.4 in.) to 95 or 90—to gain additional yardage. Thus elaborate long-sleeved dress designs can be quantity-produced only in small sizes from the cloth allowed; the larger sizes (most Russian women are short and fat to our eyes) require so much material for the body that the sleeves must be made short.

Decentralization has amplified this problem. The danger is that the resulting 105 regional enclaves will become little kingdoms, competing with each other. Voroshilov farm-machinery works in Tashkent waited two idle months for castings from Stalingrad Tractor works. *Pravda* on May 19 reported a Presidium decree that fines and jail terms up to three years will be imposed on "parochial" administrators and plant directors who work for their own area's advantage rather than for the good of the country as a whole. Also, People's Democracies (satellite countries) have been directed to make what they can make best instead of working toward independence or on their own pet projects. Thus Moscow hunts between the "tough" attitude of several years ago and the "soft" one of today. ■

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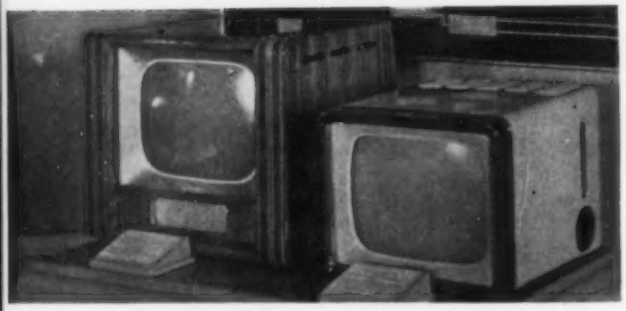
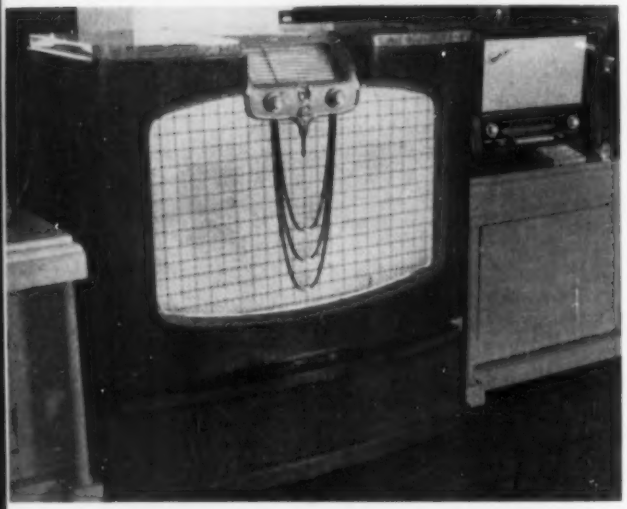
WHAT SOVIET AND PEOPLE

. . . Three Surveys

A fair indication of product development in the USSR can be gained by checking three sources: (1) the Polytechnical Museum in Moscow, (2) GUM, the USSR's largest department store, (3) The Industrial Exhibition, huge annual summer "trade fair."



TYPICAL TELEVISION MODELS generally have wooden cases, although plastics are coming in. Tubes are all glass; metal tubes with glass faces were tried, but seals between materials cracked.



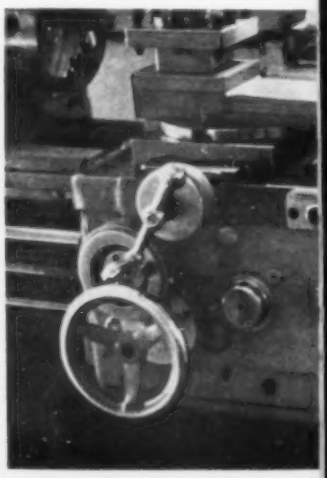
RUSSIAN JUKE BOX, a combination radio-phonograph, is made not for stores but for youth centers and camps. High volume without distortion, good reproduction without noise. At right, a standard radio of the all-wave type. Transistor radios which look like a book were made for the 1957 celebration, but are not now in production. Neither are plastic-cased battery-powered portables.

FIRST... the Polytechnical Museum

The Polytechnical Museum is a unique institution, founded in 1872 and since associated with the most progressive of Russian scientists. In its 50 halls and sections are over 20,000 exhibits, including history and present-day achievement in model, mockup, cutaway, diagrammatic and working unit. It is open to the public and to technical students. It is the equivalent of a super Museum of Science and Industry or a Smithsonian Institution in the US. Of its 10 sections, I toured five, in each case with the engineer in charge (four of five were women, and very competent). Sections toured were: machine building, metallurgy, motor cars, electricity and radio engineering, and calculating machines. Much of what I found is best shown in the accompanying pictures.

Among items on exhibit were vibratory feeders in a wide range of sizes, a planetary-thread roller capable of threads from 4 to 60 mm dia at rates of 182 to 435 per min, a complete range of calculating machines, integrators for differential equations, continuous casting of steel, semi-

PROJECTION TELEVISION sets are also made for youth and rest camps. The curved aluminum screen slides down into the wooden storage cabinet.

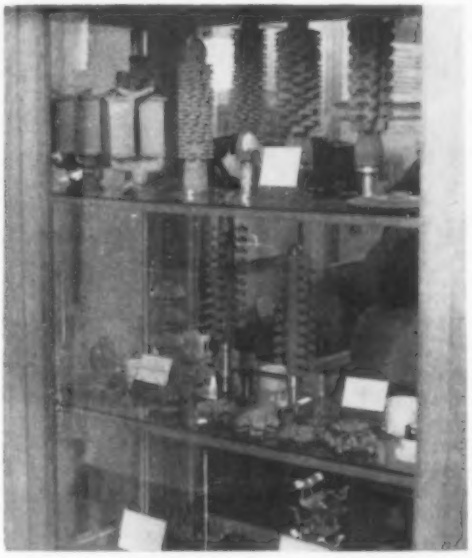


INDUSTRY CAN BUY

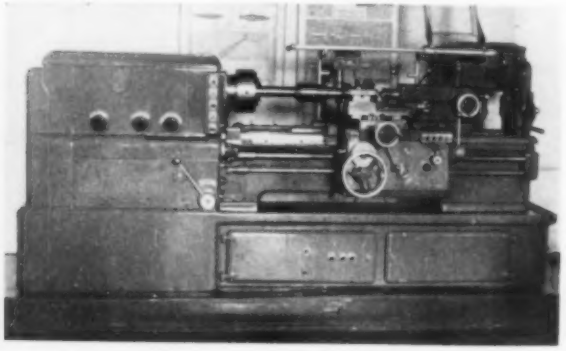
THREE CLASSIFIERS: Simplest of these sorters (above, left), gages a bolt at three points with gage leaves, drops it into one of five magazines. Another (right) has a rotary selector, classifies bearing balls into 20 boxes to a tolerance of two microns. A third (adjacent photo at left) is a more elaborate console and table model that sorts bearing rollers into 30 groups. A fourth type sorts piston rings into 10 size groups.

conductors used in telephone circuitry, extensive examples of precision casting, industrial and projection TV, transistor and tube portable radios. Engineers were quietly proud of these devices, but occasionally would become impatient of the expressions used by the special technical interpreter (a "dyed" blonde!) and burst into English phrases themselves. Apparently, they all read English well, and kept up with current developments, because they knew what was new, but they were ordinarily diffident about speaking it.

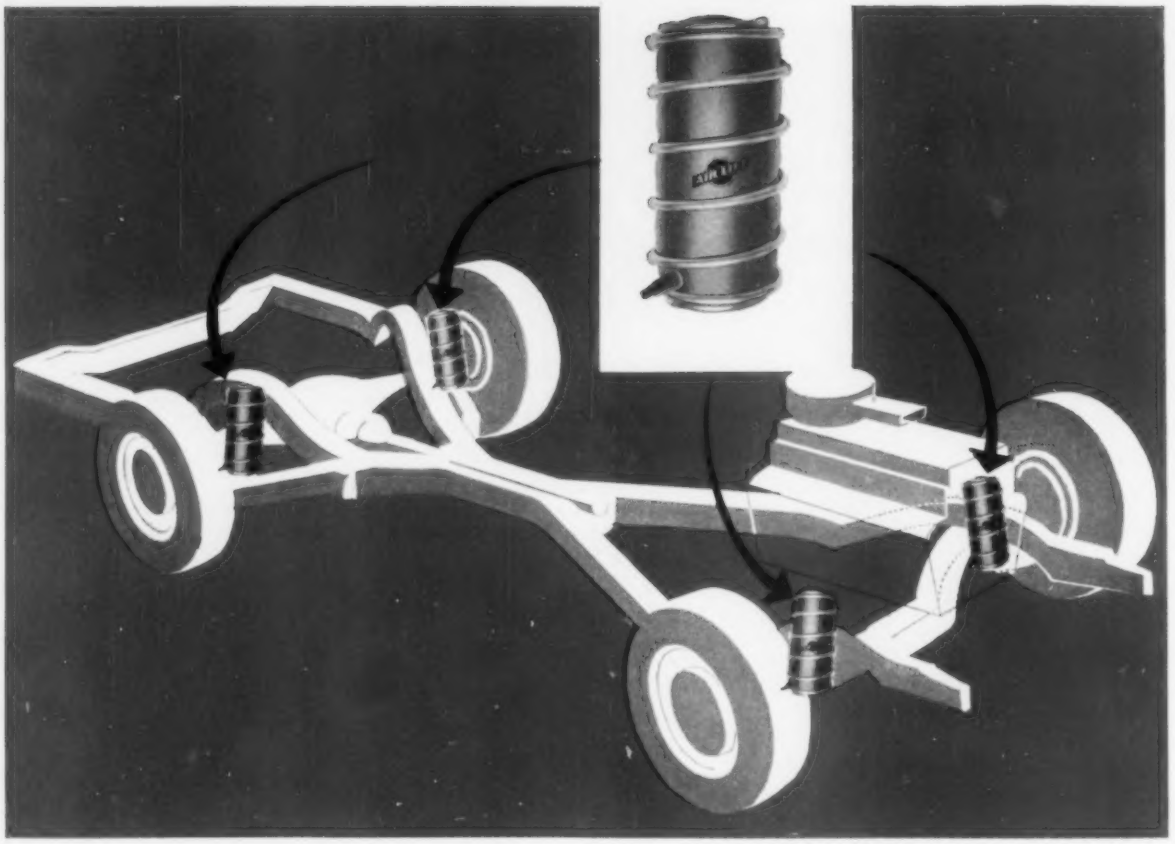
There was also a truck operating on gas generated from wood charcoal. Gas generators are mounted vertically on each side just back of the cab. They are fed from the top with 3-in. pine blocks. Such trucks form 70% of the trucking capacity in Siberia for wood hauling, have the virtue that they need not be garaged in winter, but will start readily after a night in the open. Recent models have an improved gas-cleaning arrangement to get rid of flyash as well as a much better pressurizing pump.



LOST-WAX CASTING seems to be as well established and as diversified as in the U.S. Here is a cabinet full of typical "tree" patterns, castings and parts, including cutters, turbine buckets and like parts.



THIS SOVIET LATHE has preselection for speed and feed and is equipped with automatic contouring and "joystick" control. The closeup shows the apron from another lathe, again with the joystick. The stick is shifted to any of the four directions. When the button on top is pushed, the apron or tool slide moves to match.



Pneumatic Spring Controls are made with Enjay Butyl to provide quieter, softer cushioning in automobiles.

ENJAY BUTYL

actually lets you ride on air!

Enjay Butyl Rubber is used by the Armstrong Rubber Company, West Haven, Connecticut, in the production of Air Lift Pneumatic Spring Controls for the Air Lift Company, Lansing, Michigan. Butyl Air Lift units are inserted between leaf spring and frame to support overloads and cushion all moving parts of suspension. Inflatable to meet load requirements, these units protect vehicles—provide a smoother, safer ride.

Each week the Armstrong Rubber Company turns out thousands of Air Lift units made from Enjay Butyl Rubber. They chose Enjay Butyl because of its superior air retention and resistance to aging. Since tough, weatherproof Butyl is low in cost, it may be the answer to lower production costs for you. For complete information and expert technical assistance, call or write the Enjay Company.

ENJAY BUTYL

Enjay Butyl is the greatest rubber value in the world. It's the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

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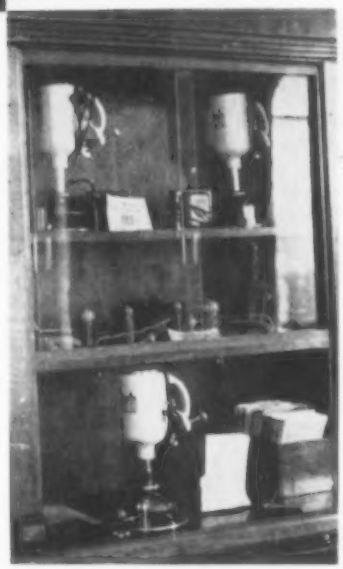
SECOND . . . Appliances for sale at GUM

VACUUM CLEANERS look like their American counterparts, were probably designed directly from them. There are two canister types, one 425 and one 400 rubles, a tank type at 650 rubles. (Minimum wage is 375 rubles per month.) A hand-plunger type washer (below) is priced at 180 rubles. There are no mixers, toasters, griddles available. Nor did I see hair dryers, curlers, heating pads or similar gadgets familar to us.

WASHING MACHINE is a standard vertical tank type with center-rear agitator. It is simple and relatively inexpensive, easy to maintain.

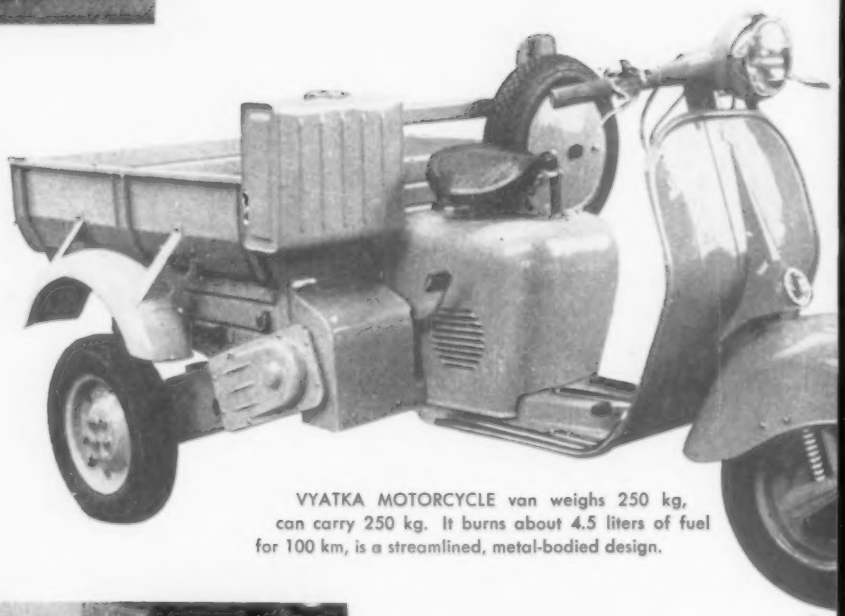


STANDARD REFRIGERATORS are these miniature models (far left), like ours on a smaller, cruder basis. They are priced from 750 to 900 rubles. At right are the new, larger refrigerator, priced at 2000 rubles, and a new washer, with hand wringer mounted on top. ZIL makes a still larger one that looks exactly like mine at home.

THIRD . . . For the Newest Equipment,

WORKERS READY a new tourist bus. Note the styling, viewing panels above windows. This is the ZIL 158, with a 109-hp gasoline engine beside the driver. Three top traps of glass can be opened at a slant so air is forced in at front and exhausted at rear. Such a bus costs 35,000 rubles.

BECAUSE OF LOW MARSHY GROUND, Soviet designers cling to caterpillar treads for heavy tractors. Here are two shots each of heavy-duty and farm-style tractors. Wheels on the farm tractors (below) are lighter than ours and frames are still used rather than using the engine as a frame as we do.

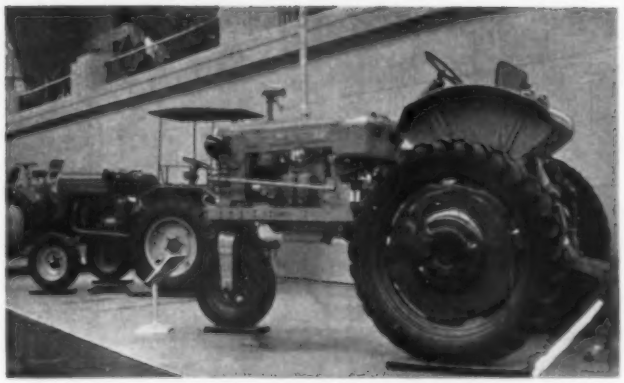


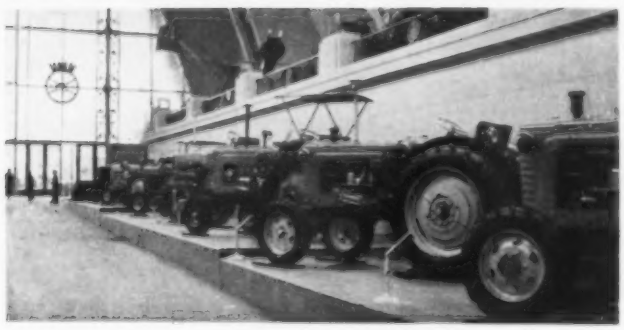
VYATKA MOTORCYCLE van weighs 250 kg, can carry 250 kg. It burns about 4.5 liters of fuel for 100 km, is a streamlined, metal-bodied design.

TWO MORE MOTORCYCLES or scooter types, one a van with wood body, the other for messenger or private use.

THE INDUSTRIAL EXHIBITION

he INDUSTRIAL EXHIBITION





A SMALL LIFT TRUCK, essentially similar to American models.

Industrial output in the USSR has increased more than 30 times over that of 40 years ago, while heavy industry has increased more than 50 times. In 1956, 800 big industrial enterprises went into operation, the country produced 89 million tons of oil, 49 million tons of steel. Power stations generated 182,000,000 kwhr of electricity.

These and other advances are shown in displays, panels, models and exhibits, as well as working tools, at the annual USSR Industrial Exhibition, organized first in 1955, which opened June 1 for six months. This is an all-industry show, aimed at educating the people. In its 21 pavilions there were 40,000 exhibits last year, including 1000 machines and machine tools, 2000 instruments, 500 models and mockups, and 300 automated processes. I was invited for a personal preview by the director, but asked not to take pictures because the exhibits were not yet cleaned up.

Pavilions are part, really, of the huge All-Union Agricultural Exhibi-

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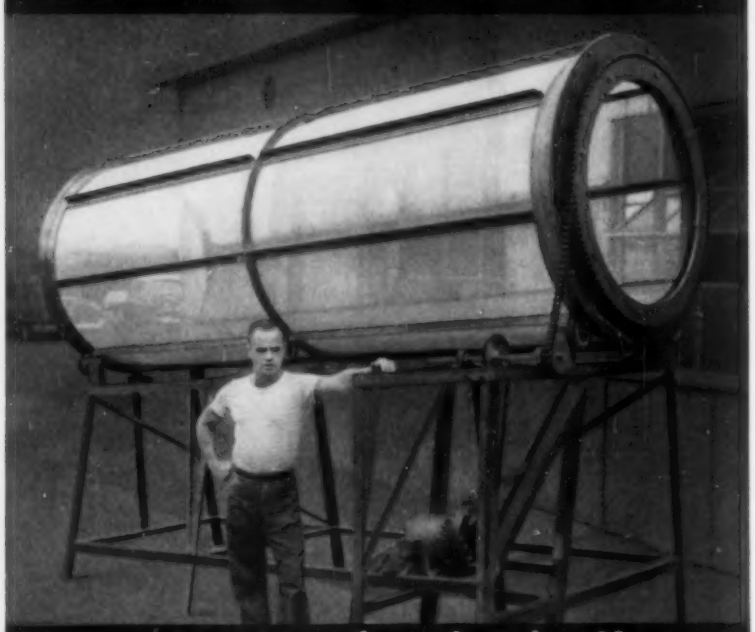

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OFFICES IN PRINCIPAL INDUSTRIAL CITIES

THE INDUSTRIAL EXHIBITION

(continued from page 31)

tion all around them. Each republic, each major organization has its own pavilion; many of the 46 are magnificent structures. The Agricultural Exhibition was opened five years ago, now has almost half a million exhibitors each year, each a medal or prize winner chosen in competition. More than 7-million visitors come each year, 30,000 of them foreigners. Grounds total about 550 acres, with more than 300 pavilions and structures having 2-million cubic meters of space. There are several tremendous fountains, many pools, statues and sculptures. There is even a Peaceful Atom Pavilion, with a working 150-kw swimming-pool reactor and dozens of exhibits in branching halls.

From industrial exhibits, I asked that only the latest developments be shown me. Here they are:

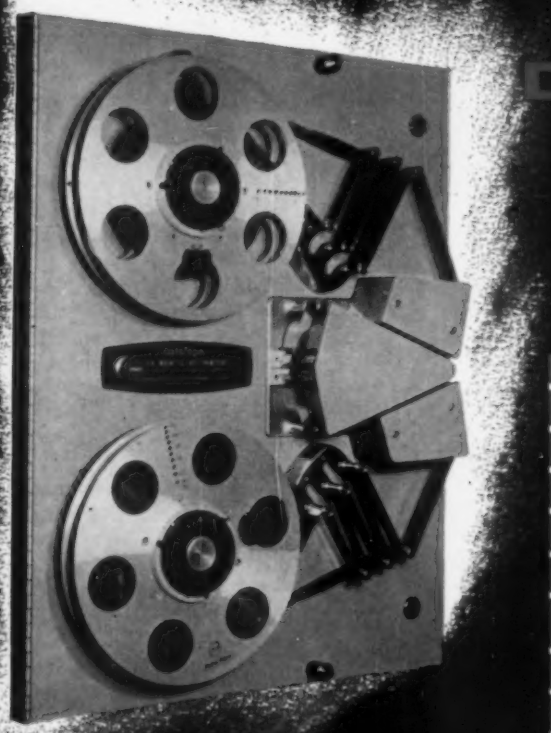
High-frequency communication for mining . . . The dispatcher can communicate with 15 shovel or locomotive operators in an open-pit or sub-surface mine. Transmission is through the power cable. Operators may have tube or transistor units, the latter being more compact and providing longer life. Range is 3 km (2 miles).

Remote-controlled locomotives . . . Ores are loaded from chutes into cars drawn by remote-controlled locomotives. An alarm system prevents mislocation of cars. The engineer explained the setup as "what you call unfooling." He meant foolproof.

Dust settling . . . To settle nonferrous ore dust for better treatment and labor conditions, the ore is conveyed on a belt past a cobalt 60 detector. Gamma ray absorption is proportional to amount of dust. A Geiger counter determines how much has been absorbed. This signal goes to a relay which controls sprayheads along the ore-carrying belt. Setup with timed separate relays is such that an individual sprayhead can be timed to wet down only the particular ore requiring it. There is also a blocking relay, so anodic current will be switched off if the conveyor stops.

Overheat protection . . . Miniature thermistors are placed at key points adjacent to motor bearings, for example. Current, which varies as heat rises, is amplified by transistors and transmitted to a control which will

(continued on page 34)



CEC announces the new **DataTape** *digital magnetic tape recorder/reproducer*

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- *uses ½" to 1¼" tape*
- *10½" reels with NARTB hubs*
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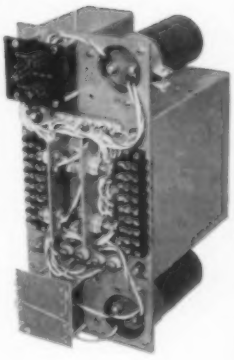

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THE INDUSTRIAL EXHIBITION

(continued from page 32)

cut the circuit as a predetermined temperature is reached. This was 90C in the setup demonstrated.

Productivity of an aluminum pot . . . Radioactive gold is added to the melt, mixed in, and a sample slug (heavy-walled tube) cast. This is passed over a Geiger counter and recorded. Sampling an hour later shows a reduction in radioactivity proportional to the amount of aluminum withdrawn. Entering the two Geiger counts in a formula gives the productivity.

Monocrystalline germanium . . . The Chekhralsky process (named after a Polish inventor) is used to remove impurities from the polycrystalline form and produce a monocrystalline shape 130 mm in diameter and 400 mm long (much larger than those common in the US). The impure metal is melted in a vacuum chamber. A water-cooled rod carrying a starting monocrystal is brought down over the molten metal. Surface tension causes the molten metal to remain attached as the rod is slowly lifted, forming a crystal with one center of crystallization. Silicon can be similarly treated, but crystal size is limited to 70 x 400 mm.

Zone refining . . . Another way to do the same job is to enter the polycrystalline rod to be refined in the top of a quartz tube. Under it is a monocrystalline bar of the same metal. The tube is exhausted, and the work heated by radio-frequency current applied to a very narrow melting zone. Molten metal joins the lower monocrystal, held in position by surface tension. The tube and bars feed down past the coil at 0.3 mm per min. Thus the monocrystal below builds up while impurities float at the top. Eventually, the top of the bar, with the impurities, is cut off. Impurity of the resulting metal is claimed to be 1 part in 10 billion.

Mercury-gas concentration . . . Mercury vapor is poisonous in any processes involving this metal. To determine concentration in shop atmosphere, air samples are pumped in, filtered, and taken into a tube that passes an ultraviolet lamp. Transmission of rays through this tube and an empty one are compared by a photocell, and the difference amplified

(continued on page 36)

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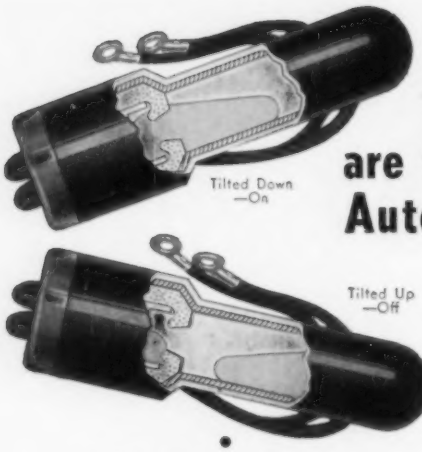

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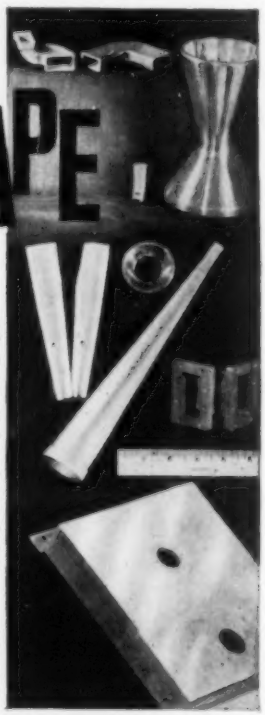

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THE INDUSTRIAL EXHIBITION

(continued from page 34)

to record or ring an alarm.

Blast furnace . . . Now being built for Siberia is a blast furnace with a capacity of 1513 cu meters, somewhat larger than any now in use. It is automated so it requires only 15 people. The furnace will work on flux agglomerate with increased pressure and increased moisture. Annual output will be a million tons of pig. It will have five pouring outlets to shorten the pouring period and reduce the number of gates. Present furnaces have single outlets, but some have been modified with a swinging spout, so pouring can be continuous, the spout filling an ingot mold on the next track while the close-in ones are moved.

In design is a blast furnace of 2286 cu meters, with daily output of 5000 tons and annual output of 1.8-million tons.

Evaporation-cooled open hearth . . . Three 500-ton open hearths using oxygen are already working that have high-resistance refractories and evaporation cooling of metal parts. Instead of cold water, this design recirculates hot water through cooling passages, steam formed being separated in a separator in the system. Water consumption is reduced to 1/60.

Electric melting . . . Studies of electric melting indicate four areas for improvement of productivity: (1) larger sizes, (2) electro-magnetic stirring, (3) vacuum melting, (4) arc heating of ingots. Vacuum melting has reduced carbon from 0.04-0.06 to 0.02%, sulfur from 0.009-0.010 to 0.005% in the two years from 1955 (final quarter) to 1957.

Continuous casting . . . Steel-project Institute has designed a 4-line continuous-casting setup. One ladle supplies the four vertical lines, which cast bars 185 x 185 mm to 300 x 300 mm. Slab length will be 4 to 6 meters, casting speed will average 0.5 to 0.9 meters per min. (20 to 35 in.). Ladle capacity will be 50 to 90 tons, productivity in a "hot" hour 50 to 85 tons.

I-beam weight cut . . . Changing the profile of an I-beam so the web is thinner and the flange has more nearly parallel walls has cut weight 10% without loss of strength.

Coal-mining machines . . . Drills, face cutters of the rotary and triple-

head types and loading equipment the equivalent of our newest was on display.

Machine tools . . . Exhibits showed equipment the equivalent of ours, including half a dozen machine tools with special modifications made by workers at the using plant. However, the newest exhibits duplicated the pictures of units described herewith at ENIMS.

Foam concrete houses . . . Latest construction material is gas concrete, a mixture of 400 parts of sand, 300 parts of cement, and 0.4 part of aluminum dust is made and poured into molds so the aluminum can react with the alkali in the cement. Hydrogen is formed, making the mixture rise like batter. Molded parts are steam-treated in an autoclave to harden them. All house parts are made of the concrete, at a cost of less than half that for brick. The material is a better insulator than brick, so walls can be thinner, but it is not strong enough for more than 2-story houses. The plant for producing the material is portable, so can be taken to a building site.

Air-conditioning . . . of Soviet mines is progressing. One new unit dropped the temperature in a 550-m (1600-ft) deep mine 5C. Another has been installed in a coal mine at 890 meters (3000 ft).

Remote control of gas and oil wells . . . A new system at a gas field in the Ukraine handles 100 points within a range of 30 km (19 mi). It checks output and pressure, records throttle position at the collector and condition of the purifying installation. Excess output at any well, or a drop in pressure in a collector flue, is shown immediately. In Uzbekistan, operation of several hundred oil wells is checked in 25 to 30 min. by an operator at a remote-control panel.

Portable TV . . . A TV camera for reporters has been developed by the Television Institute. It is a small knapsack containing a synchro-generator, video-amplifier, TV deflection circuits, and a transmitter. The hand camera weighs 2.5 kg, (5.5 lb), has a vidicon tube and electronic view finder for picture-quality control. Range is 500 m (1600 ft), total weight (with camera) is 15 kg (33 lb). Also developed is an industrial TV camera for dimly lighted places. It has a high-sensitivity transmitting tube. A variant can be used for underwater studies. ■

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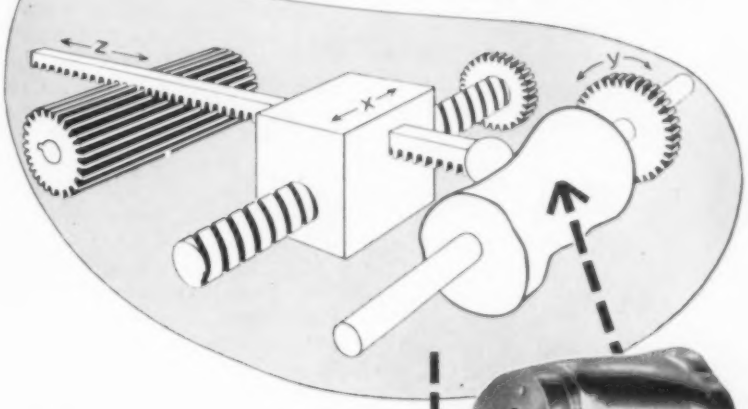

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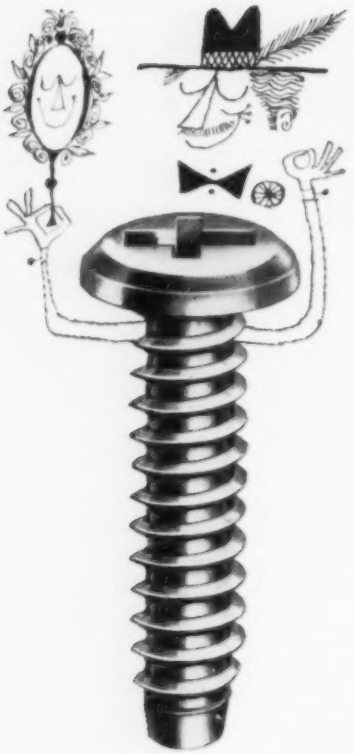

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HOW MOSCOW DESIGNS

. . . the editor reports from on the scene

The Academy of Sciences Tops All Techniques

Most respected of all Soviet institutions today—within and without the USSR—is the Academy of Sciences. We do not have its equivalent exactly. It's like the US Bureau of Standards, the National Science Foundation, Battelle and MIT combined. Its 150 members and 350 corresponding members are considered the top scientists of the country. Each works in his specialty, with every facility he deems necessary; here there are no shortages. All the Academy need do is establish need. There is an extensive complex of laboratories, expeditions and special projects employing over 35,000 people, and the Academy indirectly and directly influences all of the USSR's scientists.

There are eight main divisons of the Academy: physical and mathematical sciences; chemistry; biology; technical science; geology, geography, astronomy; history; philosophy, law and economics; literature and languages. (In the USSR, the last three groups are also considered sciences, but art, music and medicine are not included—they have their own academics.) Biggest division is the first, with biology second.

The technical-science division, which concerns us, includes machine building, mechanics, metallurgy, automation, nuclear technology, power, electronics and radiology. According to an academician who visited me, technical science is one of the smallest activities, but it has been doing work on elasticity, plasticity, fatigue stress, dynamics, vibration, and similar subjects. He had, by the way, just returned from a visit to American universities, but had not been invited to the really key ones in research.

The output of the Academy is astonishing. It publishes over 25,000 papers a year, plus its own monthly bulletin and several magazines. Because of its tremendous effect on Soviet engineering, it is worthy of a bit more examination. Its members have been major factors in development of the Sputniks. It controls the largest particle accelerator in the world—twice as big as our biggest. It helped the USSR to produce the world's first jet airliner, early-warning radar at least as good as ours, to solve re-entry problems of missiles (before we did), do oceanographic research we only contemplated, and so on. But the work is spotty; Western observers have said it is high in mathematics, physics, and geophysics, low in chemistry, biology and astronomy. A crash program has been ordered, for example, in plastics by Khrushchev; the first plastic auto body just announced, is a copy of the Ford Fairlane, complete with stubby fins and light hoods, with a European high and boxy cab put on top.

It is the Academy, too, which is responsible for the All-Union Institute of Scientific & Technical Information, which publishes abstracts of major scientific and technical papers of the world in a weekly magazine. This and an associated Institute turn out almost half a million abstracts a year, utilizing about 2000 translators.

Academy members are the elite of the country, because they do the basic research that makes other things possible. An Academy member usually has other responsibilities as well; Academician Dikushlen, for example, whom I met as a member of the staff at ENIMS, is also chairman of the Commission for Scientific Techniques of the Academy.

Yet those I met were essentially modest, quiet men. They were obviously knowledgeable in a variety of subjects, and had the ability to appraise both our work and their own. ■

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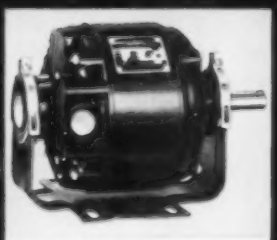

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NEW APARTMENTS in the southwestern district can be seen from the University tower. These will include their own stores, schools and the like and will house 500,000 people.

Moscow University's new campus, on the southern edge of the city, is a showplace, a must for all visitors. Its real name is the M. V. Lomonosov State University (after the first great Russian scientist), and it was founded before the United States was formed. Its central structure is a 9-story Neo-Gothic skyscraper with central tower 787 ft high (higher than any European building except the Eiffel Tower), with wings for physics and chemistry. In this one building are 15,000 rooms, including 1900 labs, 19 lecture halls seating 150 to 600 people, a 1500-seat assembly hall with marble pillars, eight crystal chandeliers each weighing five tons, and mosaic ceiling, 141 classrooms, living quarters for students and instructors, libraries for each physical science–and over 100 elevators. It was built from 1948 to 1953 at a cost of 3-billion rubles ($750,000,000 at official exchange), a third of it for equipment. Annual operating budget is 250-million rubles ($62,500,000). Thus in cost, it represents more than most of our Ivy League colleges put together.

There are about 13,000 regular students studying physical science, with the emphasis on research. Total student body is 17,000, with 6000 night-school and 1500 graduate students. There are no engineering or medical courses here; the job is to produce theoretical specialists. Some 51% of the students are women, the same ratio as in the over-all population. The 1800 instructors are elected for a 5-year period by a Council, must be re-elected each five years; there is no tenure. Instructors teach half time, do research the other half. Lectures are tape-recorded for student reference–and perhaps for checkup on the instructor, who is reprimanded if too many students fail. Starting salary is 3300 rubles; a full professor gets 5500. Some 200 professors live in the building, 600 more in flats nearby.

Curricula are standard in Russian colleges, set up by the central government. At Moscow, the course is five years, plus three for the doctorate. About 25% of applicants are accepted, 15% of an entering class fails before graduation. The course is tough–1000 to 1300 hr of instruction per year. Successful students are exempted from military service. *The great difference between their methods and ours is that every student is paid to go to college,* 300 rubles a month the first year, 500 the fifth, with bonuses for good grades. Tuition, books and supplies are free. The student pays 25-30 rubles a month for a room, 250-300 for board, so must have some assistance from his parents or by summer work in pioneer camps or the like.

Student quarters are adequate (see photo), far better indeed than most

(continued on page 42)

A STUDENT CUBICLE at Moscow University. Two cubicles like this are joined by a small entry, with WC on one side, shower and wash basin on the other.

Better Tools...

BEGIN WITH

SHARON QUALITY

ALLOY STEELS

What's new in the way of garden tools? This tool caddy, for one thing, and Sharon metallurgists know all about it.

Sharon has been supplying carbon, stainless and special alloy steels to garden and farm implement manufacturers for more than 50 years and they know the industry and its requirements.

So, if you're in the business of farm and garden tools, isn't it just good business to become acquainted with . . .Sharon Quality Steels?

SHARONSTEEL

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SHARON, PENNSYLVANIA

CHACE

THERMOSTATIC BIMETAL

ACTUATES ANOTHER PRECISION PRODUCT

THE DICTOGRAPH *Fire Detective*

You're SAFE with DICTOGRAPH

A Product of Fire Detective Inc., Subsidiary of The Dictograph Corporation Newark, N. J.

The Dictograph Fire Detective System is aimed at eliminating delay in the discovery of fire. This precision thermal detection unit is the heart of an automatic system which often makes it possible to put out fires with a hand extinguisher before there is sufficient heat to open sprinklers. The electronic system detects, notifies personnel on the premises, pinpoints location and sounds outside alarm. In reporting on the Thermal Detection Unit, The Underwriters' Laboratories, Inc. stated, "The device is positive in action and adequately sensitive. No failures were encountered in any of the tests in which the device was subjected to heating and the action was prompt and positive." The units are pre-set at either 135°F. or 185°F.

It's good to know that where life and property are at stake, Chace Thermostatic Bimetal is specified as the actuating element in the Fire Detective System. But the confidence of manufacturers such as The Dictograph Corporation is not accepted casually. Precision thermostatic bimetal has been our exclusive business for over a third of a century and the development and processing of a better bimetal continues to be our sole objective. Our manufacturing and inspection methods are rigidly controlled to assure our customers of a superior bimetal — and Chace will produce nothing else so long as there exists a demand for quality.

So remember Chace when you, too, design for protection of life, valuable equipment or for temperature actuation or indication. Dependable Chace Thermostatic Bimetal is available in over 30 types, in strip, coil or completely fabricated and assembled elements to your design. Send for our new 1958 booklet, "Successful Applications of Chace Thermostatic Bimetal," containing many pages of design data.

IT BENDS WITH THE HEAT

W. M. CHACE CO.
Thermostatic Bimetal
1607 BEARD AVE., DETROIT 9, MICH.

MOSCOW UNIVERSITY

(continued from page 40)

equivalent housing. The dining rooms are excellent and serve first-class meals at low prices. The Metro will be extended to the campus by December, so students from the city suffer no winter commutation problems.

Classrooms I visited were well designed and well equipped. Each regimen has its own reference library, plus a central reference library with a dumbwaiter system that will deliver books to the inquirer within five minutes. I saw a great many English and American books in the library, plus relatively current copies of American technical magazines, theoretically banned from circulation to the USSR. When I expressed surprise at this, the librarian said, "We will get them if we need them; why must you make it difficult?"

Moscow University is one of 33 full universities and 767 institutions of higher learning in the USSR. There are also something over 3500 *tekhnikums*—vocational schools—and agricultural schools. Over 2-million students are in *tekhnikums*, where the emphasis is on the practical. But the national student preference is for science (over 50% of the 2,000,000 in college now), because this career is less subject to political pressure, pays more, and the Government favors it.

There are many specialized training schools, also called "institutes." In Moscow there are two teaching metallurgy, for example. Moscow Steel Institute has 2000 students in ferrous metallurgy (30% women) and graduates 400 a year—about ⅓ of the US total, a fifth of the Russian. Kalinen, about the same size, teaches non-ferrous metallurgy. Leningrad Polytechnic is larger than either of these, but teaches both ferrous and non-ferrous.

There is no illiteracy in the USSR, except among the very aged. Over 200,000 schools operate in more than 60 languages, but all teach students to read and write Russian. The Soviet Union averages about seven college students per thousand of population, compared with our 17 per thousand. Engineering enrollment is, however, twice ours. An instructor-guide at Moscow University told me the Soviet Union turned out 75,000 engineering graduates last year — over twice as many as the US. ■

Introducing Allied's

IRILAC™ #1000

New Clear Protective Coating for All Metals . . . as safe and easy to handle as Water!

New method of protection incorporates corrosion inhibitors in a water-soluble polymer base. Dries to an extremely thin, tough, durable coating—clear in color. Does not chemically affect base metal or any post-treatments. Used as a protective treatment alone or to enhance value of post-treatments.

Allied's new Irilac #1000 is a concentrated solution of a water-soluble polymer with built-in complex corrosion inhibiting materials. It was developed to answer the needs of the metalworking industry for a non-conversion process that will provide corrosion resistance and resistance to fingerprinting and abrasion on base metals and electrochemically or chemically finished surfaces—without changing the appearance of the metallic surface.

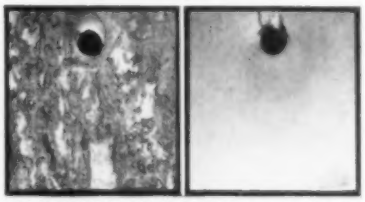
There are no hazards involved—Irilac is non-fuming, non-toxic, and requires no special fire prevention measures.

THE PROCESS

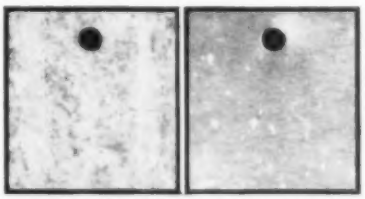
Irilac #1000 is diluted with water to provide a simple one-pass working solution. It is then applied by dip, brush or spray and forms a coating that quickly *bonds* to the metal surface without reacting with the surface.

THE PROPERTIES

The resulting coating is clear, transparent, thin yet durable. It has excellent water-resistant properties, and can be rubbed, handled and subjected to rough treatment. The surface to which Irilac has been applied is not altered—in fact, the transparent coating brings full tone to colored surfaces and clarity to iridescent surfaces. The water-thin physical characteristic of the solution means that the coating provides protection in recessed areas that are difficult, if not impossible, to protect with other methods.



STEEL PANELS: bare (left) and coated with Irilac (right) after 8-hour salt spray.



ALUMINUM PANELS: bare (left) and coated with Irilac (right) after 168-hour salt spray.

WHERE IRILAC CAN BE USED

Irilac #1000 can be applied to *any* metal—wet or dry—treated or untreated. All metals can be processed in *one* operation in the same solution. It can be applied in conjunction with any process—over Iridite, anodized, phosphated surfaces, black oxide, etc. Surfaces treated with Irilac provide a good base for paint.

APPLICATION ADVANTAGES

No other process or material available for the protection of metals offers all the application advantages found in new Irilac #1000:

1. It can be applied to any clean metal simply by dip, brush or spray. No special equipment is required.
2. Saves time—just apply and dry—no reaction time required.
3. No hazards involved—no exhaust or special fire protection equipment is required. Irilac is non-fuming and non-toxic.
4. Saves space. Presents no disposal problem. Low in first and final costs.

Because of its versatility and complete safety, Irilac has unlimited uses. For example, it will protect aluminum furniture, brass hardware and fixtures, steel parts of all types, zinc castings, etc. In fact, any base metal or plated surface, or those treated with electrolytic or chemical post-treatments, can be improved or enhanced with Irilac.

IRILAC #1000 MAY BE THE ANSWER TO YOUR PROTECTION PROBLEM

Our development staff will be glad to work with you to determine the significant benefits Irilac can offer you. Simply send us some parts and let us show you what Irilac can do. No obligation, of course.

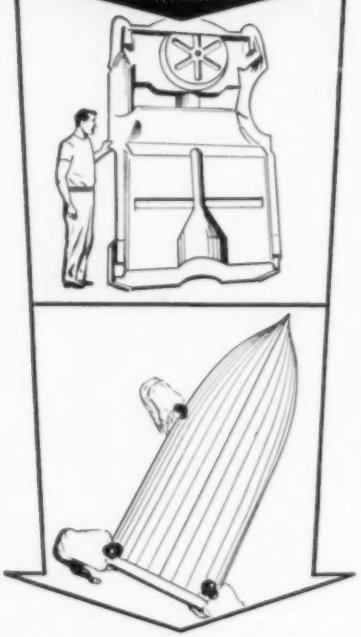
Allied Research Products, Inc.

4004-06 EAST MONUMENT STREET
BALTIMORE 5, MARYLAND

***Manufacturers of* IRIDITE®, IRILAC™, ARP® Brighteners and Plating Chemicals**
West Coast Licensee: L. H. Butcher Co.

Large parts, too, can be mass-produced of strong, lightweight

MOLDED FIBER GLASS



No longer must you use the same old metals for your larger pieces. Now you can modernize your products and spruce up designs with tough, economical MOLDED FIBER GLASS.

Molded Fiber Glass Body Company can custom-mold your big products of strong, lightweight, rust-proof, impact-resistant MOLDED FIBER GLASS, using matched metal dies...

with savings of 50% in tooling time and 80% in tooling costs!

And... MOLDED FIBER GLASS parts can be molded into shapes impossible to make with metals... complex, one-piece, deep-draw parts ... pigmented in any color, or painted.

Molded Fiber Glass Body Company has been successfully mass-producing large parts for the transportation industry for over five years ... gaining experience and production know-how unexcelled **anywhere.**

What about switching to MOLDED FIBER GLASS for your large products? Write today for free literature and cost estimates.

Molded Fiber Glass Body Company

4623 Benefit Avenue, Ashtabula, Ohio

NOW **MOSCOW DESIGNS**

• • • *the editor reports from on the scene*

The Largest AUTO PLANT does its own DESIGN

Likhachjov Automobile Works, named now after the man who was director there for many years, (originally the Stalin, then the Moscow plant), is the largest auto plant in the USSR, and employs 50,000 people, 30% of them women. While it is called an "automobile" plant, and it does produce the ZIL, largest Russian luxury limousine, its main output is 400 4-ton trucks and 25 buses a day. It also produces two bicycles a minute, as well as a large refrigerator.

Some 60 shops make up this complex, which produces all components except electrical equipment, steel, lumber, plastics and bearings. It has forging, casting, machining, tool, assembly and test shops, as well as a complete design department. It even designs and builds a unit drill head and built its own bevel-gear machinery initially.

There is, of course, an automobile institute, just as there is for machine tools, called NAME (Scientific Automobile Motoring Institute), but it deals principally with preliminary research, broad problems on the scientific end, and control and criticism of actual designs. The institute did design a small car called the Bilka (Squirrel) to be made in Siberia, but this car has not yet gone into production.

Thus Likhachjov does its own design and redesign, and in general follows American principles in design and manufacture as "the most modern and most suited to our problems," according to my guide. Engineers are quite frank about this; they see no reason to waste manpower doing an original job on something already done. Their designs lag three to five years behind ours and are simpler in detail for ease in manufacture with people of limited skill. Also, they modify the springing, "because we do not yet have highways as good as yours." But they have abandoned diesels for powering city buses

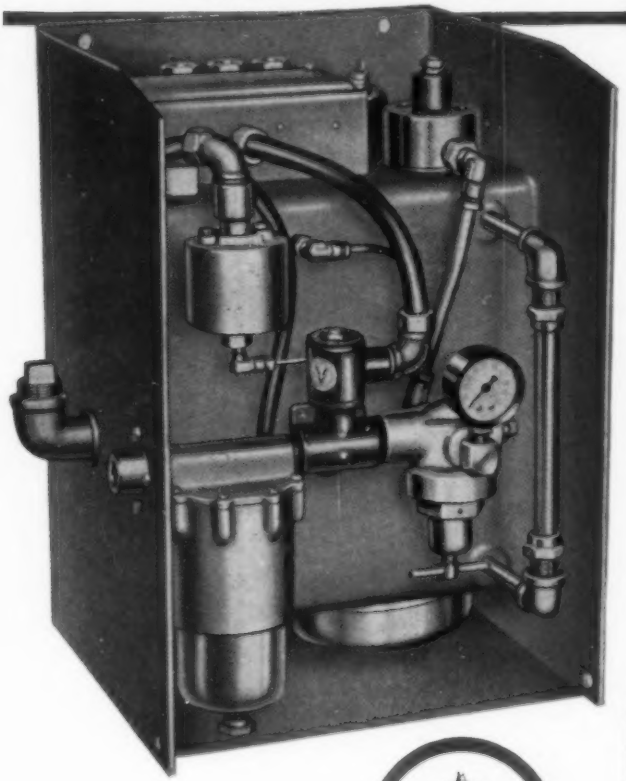
(continued on page 46)

NOW! An Automatic Lubrication System with

300-500
bearing inch capacity

Oil-Mist Unit atomizes oil and distributes it through tubing to all lubricated mechanisms.

ALEMITE oil-mist



provides safe–sure–continuous–foolproof lubrication!

- **Large Models Designed for Large Machines!** Designed to lubricate up to 500 Bearing inches. (1 Bearing Inch equals 1 inch of Shaft Diameter.)
- **Big Lubricant Supply!** 3-gallon capacity tank holds enough oil to provide a "48-hour week" of continuous lubrication for 500 Bearing Inches.
- **Extensive Coverage!** System is efficient in small, compact installation or extended over a distance of 480 feet.
- **Multiple Controls!** Automatic controls regulate air pressure, Oil-Mist delivery, check system operation and guard oil level.

Alemite Oil-Mist Lubricates all types of mechanisms

STEWART SW WARNER

ALEMITE

REG. U. S. PAT. OFF.

Division of STEWART-WARNER CORPORATION

Mail coupon for full details!

Alemite Division of Stewart-Warner, Dept. AA-78
1850 Diversey Parkway, Chicago 14, Illinois

- ☐ Please send me a FREE copy of your new and complete Alemite Oil-Mist catalog.
- ☐ Please have your Alemite Lubrication Representative arrange a no-obligation demonstration.

Name _____

Title _____

Company _____

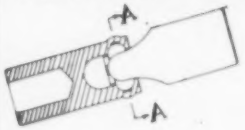
Street _____

City _____ State _____

MINI-JOINTS*

***Miniature Universal Joints with ZERO BACKLASH**

for greater freedom in instrument design



Features • Zero backlash • Maximum operating angle of 30° • Lightweight • Sealed-in Lubrication

DIMENSIONS

Part NO.	ID	OD	OL	WGT.
SBS	SOLID	3/16	1-1/32	
1BS	.0938	"	"	.005
2BS	.125	"	"	"
3BS	.156	9/32	1-3/8	.013
4BS	.1875	"	"	"
5BS	.2188	3/8	1-3/4	.031
6BS	.250	"	"	"

(Also available as double joints)

Send for further information . . . available promptly on request.

FALCON MACHINE & TOOL CO., INC.
209 CONCORD TURNPIKE, CAMBRIDGE 40, MASS.

CIRCLE 77 READER SERVICE CARD

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Need plastic parts fast? On-time deliveries every time? Come to Chicago Molded where unbeatable facilities assure you of fast, quality production of anything from the smallest to the largest parts made—*in any quantity*. You save money, too—our expert design staff works for you with the skill from 18 years' experience . . . helps you eliminate costly frills. If you want action—call:

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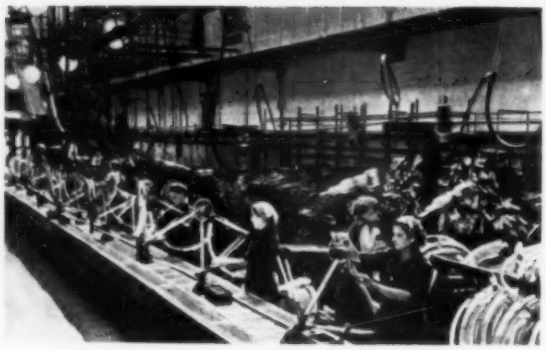
NOW MOSCOW DESIGNS . . . *the largest auto plant*

(continued from page 44)



"ROADSTER" bicycles come off this line at a rate of two a minute. The technique is American, with Russian overtones.

THESE APARTMENT houses, typical of the modern Moscow design, are built by Likhachjov for employees.

ZIL-150 4-ton truck is a standard in the USSR. Note the high wooden body and simple structure.

ZIL-151 is a 3-axle version for heavy-duty service

THE PLANT has its own hospital with a staff of 300, and this Palace of Culture, with recreation and "do-it-yourself" facilities for adults and children. There are meeting rooms, a kindergarten, and private out-of-town Pioneer Camps and a rest home for convalescents.

(story starts on page 44)

and trucks "because municipal authorities dislike the smell." (Friends of mine in the oil business say the USSR probably has a natural high-octane gasoline, while its diesel fuel is not of a quality to minimize smoking.)

Special machines are under development all the time, current ones including hopper-feeding devices, an automatic welder for driving axles and another for propeller shafts both utilizing powdered flux for protective atmosphere. The plant also makes most of its own measuring equipment, has developed the "American Tocco

(continued on page 48)

There's a *Bird*
JEWEL BEARING
to fit Your Need!

Bird can supply you with sapphire and borrosilicate glass precision jewel bearings in a wide range of standard types, sizes, and complete assemblies — or, custom-built to your specifications. Special mounting techniques provide exact tolerance jewel assemblies, mounted or set in bushings or screws, ready for assembling into your product without further inspection. Jewels mounted with resilient silicone rubber or spring cushions provide additional protection to shock and vibration.

Because of the exact tolerances, maintained through the most rigid quality-control methods, Bird jewels are used by the foremost manufacturers of electrical, aircraft, and timing instruments — and recorders.

Typical products include:

Aircraft Instruments
Weather Recorders
Ammeters
Voltmeters
Wattmeters
Compasses
Dial Gages
Timers
Test & Recording Instruments
Marine Instruments

**Illustrated — Concentricity check of mounted ring jewels — one of the inspection processes in Bird's quality control program.*

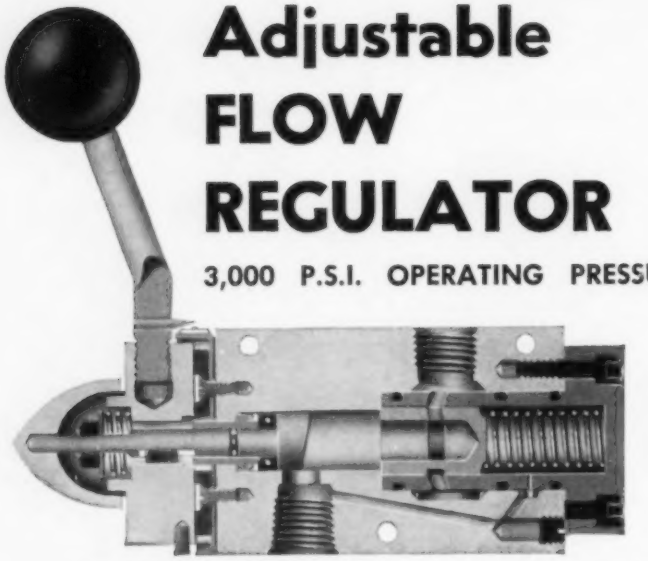
Our engineering staff is at your service for all small bearing problems. A request on your letterhead for Bulletin 100-6 will receive our prompt attention.

Richard J. Bird & CO., INC.
1 SPRUCE ST., WALTHAM 54, MASS.

SAPPHIRE & GLASS JEWELS
PRECISION GLASS GRINDING
JEWEL MOUNTING & ASSEMBLY

Adjustable FLOW REGULATOR

3,000 P.S.I. OPERATING PRESSURE



MODEL 1407 Series

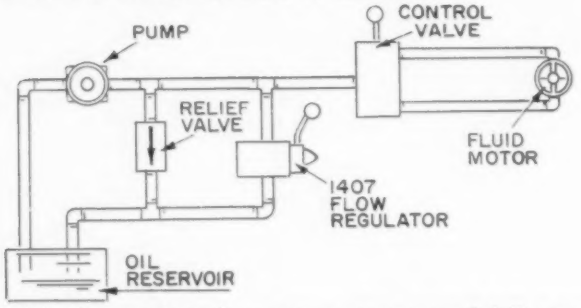
New applications for economical methods of controlling fluid motors and cylinders has prompted our company to design a full range adjustable flow regulator.

Ordering Data

MODEL NO.	MINIMUM	MAXIMUM
	FLOW IN G. P. M.	
1407 R-4-12	0.5	12
1407 L-4-12	0.5	12
1407 R-4-20	0.5	20
1407 L-4-20	0.5	20

R RIGHT HAND—Clockwise rotation from closed to open facing control handle.
L LEFT HAND —Counter clockwise rotation from closed to open facing control handle.

PROBLEM: To control fluid motor at constant speed



Model 1407 regulator is a pressure compensated full range adjustable regulator that will maintain constant flow regardless of pressure or load changes. Circuit above allows operation at a pressure equal to load pressure on motor. Speed of motor is controlled by regulating by-pass to reservoir.

WRITE FOR SHEET 1.04

Other Waterman products:

- **Solenoid Valves**
- **Check Valves**
- **Unloading Valves and Filters**

WATERMAN ENGINEERING COMPANY

725 CUSTER AVENUE EVANSTON, ILLINOIS

LARGEST AUTO PLANT

(continued from page 47)

process" for brazing, produces milling and hobbing cutters with blade-section inserts. Plastic dies are not used to any extent as yet. Actual construction is done in a 20-year-old tool shop employing 2000 people in two shifts. This shop has the most skilled men in the plant, including a number who are paid 2000 r/mon. A new die shop is now under construction.

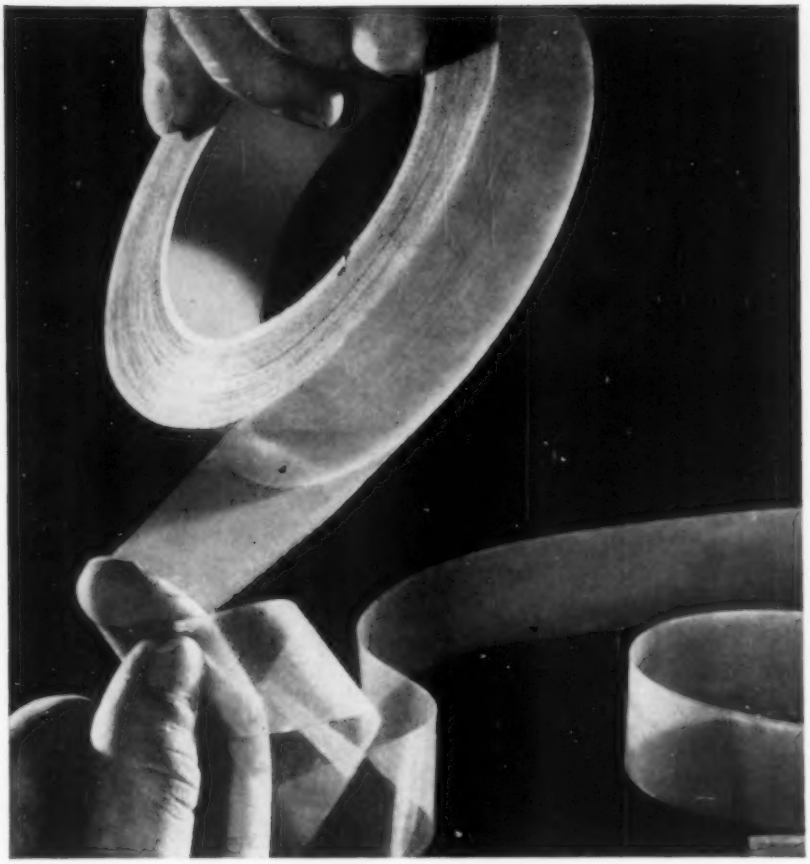
Likhachjov was started from a truck repair shop 30 years ago. It still makes trucks, 2-axle and 3-axle, with a low wood body. The 2-axle job has a 33-kg, 100-hp gasoline engine with special high-efficiency cooling and heating systems to take care of hot summer and frigid winter weather. The radiator is fronted by a manually operated shutter to protect against the cold. Air brakes are standard.

Most expensive product of the plant is the 32-passenger, ZIL-127 intercity bus, which sells for 150,000 rubles. It has a cross-mounted rear engine with mechanical transmission. This is a 6-cyl, 200-hp diesel. The all-metal body is of the suspension type, steering gear is of the hydraulic servo type, brakes are air-operated. Driver's compartment is entirely separate, as on most Russian buses. Windows are of safety glass, seats are the airplane type, walls are sound and heat insulated.

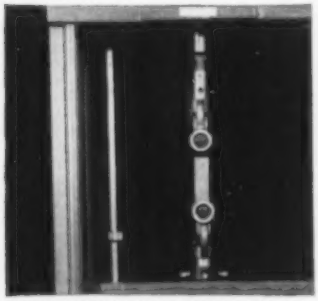
The city bus, ZIL-158, has a 109-hp, 6-cyl, gasoline engine beside the driver, costs 35,000 rubles. The plant also produces two bicycles a minute (1800/2-shift day). They have welded rather than brazed frames. Sales price is 600 rubles.

Because of its size, the plant has installed many of its own apartment buildings. It is currently building new housing at a rate of 700 three-room apartments a year, about 30,000 sq meters of area. Rent will be less than 5% of the average wage.

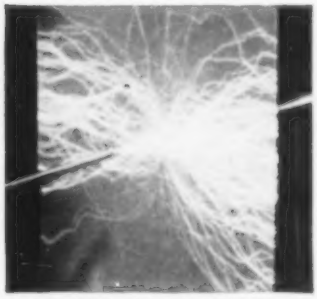
There are two technical institutes to assist the worker who wishes to study, plus a number of special training courses, groups, etc. Most of these are conducted by the plant Palace of Culture, which provides workrooms, libraries, lecture halls and the like for grownups, plus play, study, nature, art and similar rooms for some 2000 children. The company also operates a rest home, Pioneer Camps in summer for the youngsters, and similar services—even a plant lottery, which was paying off when I was there. ■



"MYLAR" *offers a unique combination of properties valuable for electrical design*



HIGH TENSILE STRENGTH. "Mylar" is the strongest plastic film. Instron tester shows an average strength of 20,000 lbs. psi.



HIGH DIELECTRIC STRENGTH. Average of 4,000 volts per mil... average power factor of 0.003 at 60 cycles.

Is there a thinner pressure-sensitive tape that's better-performing . . . and at a lower cost?

Yes, there is such a tape, and it's made with Du Pont "Mylar"* polyester film. For most applications, tough, durable pressure-sensitive tape of "Mylar" *actually cost less*, per linear foot or yard, than tapes made of other materials. That's because "Mylar" permits tape manufacturers to use thinner gauges without any loss in performance.

And what about performance? Here are some of the outstanding properties of "Mylar" found in pressure-sensitive tape:

THIN, YET STRONG
. . . average tensile strength of 20,000 psi.
DURABLE
. . . under both high and low temperature use.
FLEXIBLE
. . . gives snug wrap over irregular surfaces.
HIGH DIELECTRIC STRENGTH
. . . average 4,000 volts per mil.
DIMENSIONALLY STABLE
. . . can be used in areas of high humidity.
MOISTURE-RESISTANT
. . . resists mildew, most chemicals.
RESISTS EDGE FRAYING
. . . has great tear and impact strength.
RESISTS HEAT AND COLD
. . . can be used in class B insulation systems.
NO PLASTICIZER
. . . can't dry out or embrittle with age.

You name the job . . . electrical insulating, color coding, masking for electroplating, harness-wrapping coils . . . and you're sure to find pressure-sensitive tape of "Mylar" can improve performance while lowering costs. What's more, this thinner tape can help decrease weight and size of finished products without any loss in performance!

Pressure-sensitive tape of "Mylar" can now be obtained in a wide variety of gauges, widths, colors, and with different adhesives. Ask your supplier to help you evaluate all the factors involved in cost and performance of tape made with "Mylar". Or, send today for a list of tape manufacturers and a booklet on properties and applications.

DU PONT
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING
. . . *THROUGH CHEMISTRY*

DU PONT **MYLAR**® POLYESTER FILM

*"**MYLAR**" is Du Pont's registered trademark for its brand of polyester film.*

E. I. du Pont de Nemours & Co. (Inc.)
Film Dept., Room P-7, Nemours Building, Wilmington 98, Delaware.

☐ Please send me information on the advantages and uses of pressure-sensitive tape made with "Mylar" (MB-6).

☐ Please send me information on properties, applications and types of "Mylar" available (MB-11).

Application_____
Name_____
Firm_____
Address_____
City_____ State_____

. . . the editor reports from on the scene

ZIL presents this badge to visitors. Others are pictured on pages 13 & 30

the SOVIET ENGINEER and His Rewards

What is the background and position of the Soviet design engineer compared with his US counterpart? Much has been reported about his training, but very little about his relative position in the economic life of his country, about his working conditions, his incentives, the forces which motivate him.

Actually, it is difficult to evaluate these factors with a US frame of reference, or to compare the two countries with any degree of exactness. For example, the diploma engineer is respected all over Europe to a degree he has never achieved in the US. And financial reward is not so important a criterion there, although in the USSR greater emphasis is placed on this factor. The basic USSR pattern of incomes, for example, is not a dependable criterion, because the individual may receive bonuses, additional compensation for committees, consulting work, or other jobs. Some estimates place the income of an academician at three times his base salary or more, to say nothing of his prestige and life tenure.

First, let us establish some monetary incomes. Minimum wages have recently been raised in the USSR, to 375 rubles per month in Moscow, 325 rubles elsewhere. This wage is paid to street sweepers, waitresses and the like. The ruble is officially worth 25 cents, but is sold to the tourist from outside at 10 cents. In actual buying power compared to the dollar, it is probably worth 13 cents, half its official rate.

In any case, the starting worker (male or female) in a Moscow metalworking plant is paid about 500 rubles a month. This rises to 1050 for the medium worker and 1500 for the quality worker, even to 2000 for a skilled diemaker or a foreman. Average basic industrial wage has been estimated at 750 r/mo generally, 800 in Moscow. Many operators are on piecework, so will earn above their basic wage. Also, if a worker makes a significant contribution to his plant–a new tool, idea, suggestion, high performance, etc.–he may receive a bonus of as much as several thousand rubles. His picture will be posted on a huge honors board for six months or a year, then transferred to a permanent record book available to all in the company "Palace of Culture." All in all, the skilled man who'd rather run a machine than do engineering work or handle people can expect not to lose money by the decision.

The new engineer starts at 900 rubles, can work up to 1500 as an experienced man. A chief engineer can get 2000. But here is a significant fact: Academic accomplishment results in decided income advantages. The "Candidate of Technical Science" (equivalent of our Masters) gets 2700 rubles per month, the doctor (not a college degree, but granted after some years of research and a noteworthy contribution to science, say at age 35) 4000, the academician 6000 (base salary). If a new machine is developed and proves to be successful, the engineers involved in its development may receive bonuses of 2000 to 5000 rubles each, depending on value of accomplishment. This may happen once every year or two. Also at the end of each year, a successful enterprise may award all executives bonuses reflecting the degree of success. (The two or three top engineers and scientists who guided development of Sputnik I were made academicians shortly after it orbited successfully.)

Just for comparison, here are relative costs of some typical items in Moscow stores:

	Rubles
Outboard motor	2500
Small refrigerator	2600
Vacuum cleaner	450
Sewing machine	5000-10,000
Filet garnished	15
Hotel dinner	25-40
Chocolate bar	12-17
Champagne	30-35
Box of chocolates	82
Jar of caviar	15.4
Shirt	72
Hat	150
Suit	800-1600

It is interesting to note in this connection that a university teacher gets 3300 rubles a month, (about double the experienced engineer's salary), a professor of 10 years experience 5500–almost on a par with the academician. These figures show quite a contrast with American evalua-

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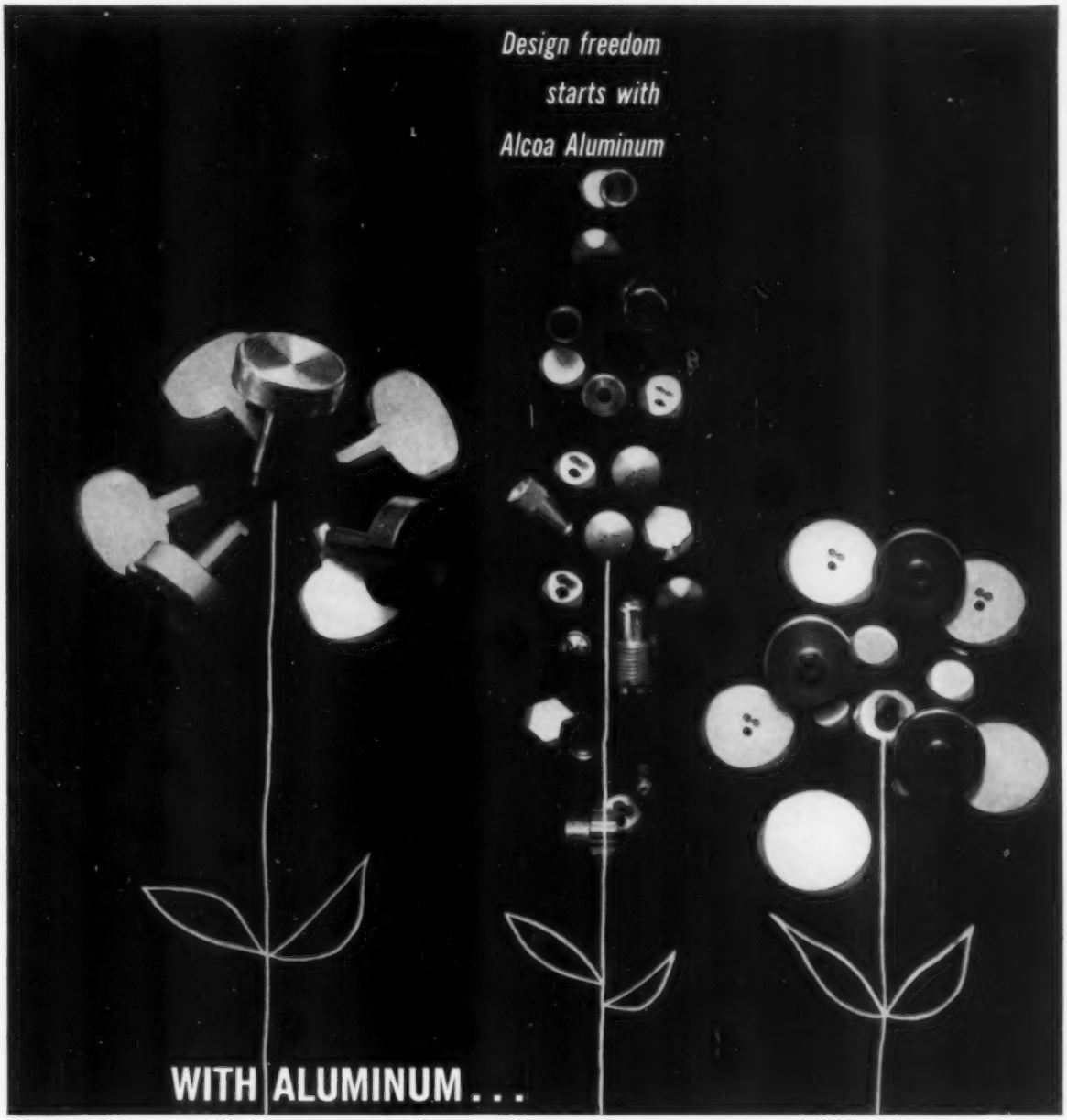

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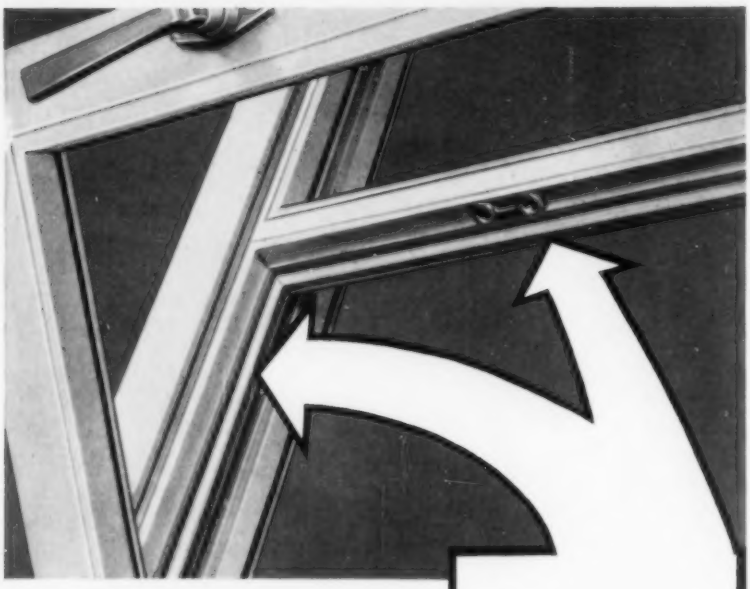

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SOVIET ENGINEER

(continued from page 50)

tion of the same profession. (Elementary teachers start at 580, higher grades 700, with a 10% raise every five years, retirement on 350 r/ mo pension after 20 years.)

Commutation by electric train from the suburbs is 12.5 rubles per month for 11 miles, with a reduction to 41 r for 4 mo. A 17-mile commuter pays 27 r per month. These rates are far below relative US prices, as are commuter rates elsewhere in Europe.

My guess is that the average engineer has about the same working conditions relative to the general economy, as we do here. He has more prestige. He has fewer tools, man for man, and fewer mechanized aids in most cases, but these shortages will be remedied as the economy develops. Instead of a calculator, for example, he may use an abacus, and most of his experimental setups will not be blessed with the elaborate sets of matching instruments we consider our right. (On one experimental setup for measuring wear I saw, no more than two of some twenty pressure gages were of the same type and vintage.)

Likewise with the chief engineer's office. He is likely to have ancient, heavy furniture, a table instead of a desk, a great deal of "make do" instead of replace. His secretary, if he has one, is really a receptionist. She probably has no typewriter, and no other desk tools. He has shelves and cabinets to store materials and data, but probably no file cabinets. He has poor service on prints and photographs.

Some limitations on design also exist that do not plague us. There is no emphasis whatever on appearance design; "over-elaborateness" is frowned upon as a waste of time, money and materials. Also, designs must incorporate standard components, unless standard components cannot be made to work. In most instances, designs must be massive and to wider tolerances than ours, because production control is not yet as close. And liaison between design and production, as well as between theory and experimenting, is not as good as it is here.

There is a nation-wide association of engineers, with divisions for the various disciplines. Mechanical engineers have a journal, national, district and

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Proctor

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SOVIET ENGINEER

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regional meetings, inspection trips and the rest, just as we do. In addition, there will be a chapter for each discipline in each major plant, operating as a division of the city chapter or branch. This is quite effective, because thus mechanical engineers can discuss problems "in the same technical language," as one engineer said.

Now, let us attempt to sum up by evaluating these factors in American terms: My guess would be that the Soviet engineer, man for man, has greater prestige and position, but a lower standard of living and far less favorable working conditions. His income represents half or less of that of the American engineer in buying power, even including his greater incentive pay (while the income of the lowest-paid worker is perhaps a third that of our minimum-wage earner).

He seems to have tremendous faith in the future, both of his profession and of his nation. He is dedicated to his work and to what it can contribute to the country's development—and he can see the effects of it much more clearly than we can in our complex economy. To him, our achievements and our position are the goal, because he feels we are ahead of the rest of the world in most respects. He's proud of what he has done, but sees there is a great deal more to do—a challenge to any engineer worth his salt.

He probably has no car and his living quarters are a room or two in a big apartment building. He has all the personal possessions the American engineer does—lighter, wristwatch, fountain pen, ballpoint pen, (but probably no mechanical pencil—they're not popular), cigarette holder, ring, camera, etc. His clothes, while less formal in most cases, compare fairly well, although he probably has only half the American wardrobe. He probably knows a great deal more about the arts, the humanities, and other engineering disciplines than his American counterpart. He is an inveterate tourist and data gatherer—usually can quote comparative American statistics on many subjects.

In general, he is happy and reasonably comfortable. He lives better than his forebears and most of his contemporaries. In a very polyglot society, he ranks near the top. ■

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Publisher's Postscript...

it belongs to YOU

Last October the Soviets surprised the world—not so much by what they accomplished, since space satellites were an anticipated part of IGY—but by how soon and how much they tossed into orbit. Few Americans suspected that Soviet rocketry was that far advanced—though the published hints were certainly there for the taking.

We won't be surprised again.

Today we watch Soviet engineering and science with as much care as we read or listen to Khrushchev's speeches. But too often the watchers are journalists, not engineers. Which is why Editor Tangerman made this trip, and why we bring you this special issue on Moscow today.

We would never devote an issue to just one subject unless we sincerely believed that by doing so we were rendering our readers a distinctive service. Tangerman's report of ten aspects of the USSR gives you a well-rounded picture of the kind of technical competition we face. The Soviets are far behind us in many ways—but they're moving up fast in engineering education, in pure science and even in consumer industries. These are things we have to know.

Tangerman was not concerned with the political climate or social problems, though when the Soviet atmosphere affects their science (as it often does) he traces the influence and explains the cause. But the primary purpose of this trip was for technical information. What are Soviet engineers doing? How do they get their training? How do they work?

To get the background information for this report Tangerman traveled over 13,000 miles. He interviewed engineers and executives in manufacturing plants, universities and government bureaus. He visited two fairs—Brussels and Hanover—as well as the Industrial Exhibition in Moscow. He spent time with our resident editors and correspondents in London, Brussels, Bonn, Zurich, Milan, Paris and Stockholm—describing what PRODUCT ENGINERING readers want by way of technical information and how to get it.

This kind of editorial service is expensive—but it's worth every penny. It represents our R & D expenditures which will pay off in exclusive and better issues like this one.

If you like an issue devoted to one subject, or if you don't like it, why not write Editor Tangerman and tell him so? Ask him questions, too. What he has learned was collected for you, and by rights belongs to you.

—A. H.

If You Visit the USSR on "BUSINESS"...

1. The vital element in getting anywhere in the USSR is planning and prearrangement. You simply cannot enter the country unsponsored and unknown and expect to see anyone. Everybody will be sympathetic, but no one is likely to do anything about it. Intourist is set up to handle tourists—visitors to architectural features, historical shrines, galleries, museums. Currently, it is badly overloaded and its methods are archaic. It does not have contacts with ministries or "business" (really a misnomer in Russia). There are no city directories, no telephone books. The alphabet is almost totally different from ours (32 letters) and the language is very different. Visits must be arranged in advance. *Then* Intourist will try to get you the phone number, or supply a car for a visit.

2. The Russian workday is broken into two halves (as it is in Europe generally), the interval being taken up by a heavy meal and rest. As dinner hours are staggered between 12 and 3, you may find you have one interview at 12 noon, and another at 4 PM. Rarely will you have an interview before 10. The usual visitor eating hours are 1 or 2 PM, and the usual closing hour is 5 PM, but you'll find your man may stay to 7 PM to finish his business with you and think nothing of it.

3. The Soviet telephone system is tricky. If you dial a number and get no answer, you may have to let the phone "cool off" for a few minutes before you dial again. There is a great deal of noise on the line, so it is difficult to hear, even over short distances. Lines are frequently busy, and important men have direct private lines—no secretaries.

4. You'll hear that English is commonly spoken. This is true among engineers, but many read English without speaking it, or speak it poorly and hesitantly. German is a much more common language, particularly among service people—taxi drivers, maids, concierges, desk personnel in hotels and at gates. If you know some German, and no Russian, bone up on the former before you go.

5. If you're timid, be a simple tourist or join a delegation where you'll be shepherded all the time. Even a restaurant can be hell on wheels, even when you work from a multi-language standard menu. Your milk will come hot, your drinks tepid, and so on. The Russians prefer delegations, which can be arranged for, and reciprocity in visits.

6. Be prepared for delay. If you ask a man to call you back, wait 24 hours at least before you become upset. If in 48 hr, he doesn't call you, call him again. You'll find he just hasn't gotten to it. If you ask for an appointment, expect it in 24 or 48 hr—not at once as in the US. And expect royal treatment when you get there—meeting at the door, etc. If your man wants to do you honor, he will even come to visit you at your hotel. But expect visitor business to be done at about 20% American speed —or less. Europe in general moves at half our pace, in

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IF YOU VISIT THE USSR

Russia at half that. There is much more courtesy, much more evaluation, much more deliberateness.

7. The best Soviet hotels are not near our standards. Don't expect frozen foods, orange juice, breakfast dry cereals. Usually, you provide your own soap. If your bath and basin both have plugs, and your toilet doesn't run constantly, you're lucky. Your bed will be hard by our standards, with a cover that's a heavy blanket (three times as thick as ours) enclosed in a sheet envelope. You'll have two big square pillows. There'll be a table with cloth in your room for food. The water is hard, and may physic you, so you'd better stick to mineral water in bottles (about 12 cents a bottle). Towels are small and hard. Nobody shines your shoes, and you do your own valeting.

8. Don't be condescending, and don't try to be a "missionary to the heathen." Russian engineers dress and act like you do—only more properly and courteously—but many citizens wear no ties, no coats, may need shaves, gobble or gulp food. They don't like tips nor patronizing handouts of ball-point pens, etc. Remember that these people have come a long way in 40 years, that their standards are not ours, and you have no reason to feel superior. Anybody may sit at your table in a restaurant, if there's a place. He'll ask first, however, as a matter of form, and thank you for permission to sit. He'll peel an apple before he eats it, he may eat bread with knife and fork, and so on—Emily Post and Russian manners do not agree. But he'll never take a topcoat or hat into a dining room, and he won't blow cigarette smoke in your face. (Smoking is very restrained, and then almost always cigarettes. If you see a man smoking a pipe or a cigar, he's probably a tourist. If you see a woman smoking, you know she is.)

9. Your Intourist food coupons (for four meals a day) may get you into trouble. Current values are 16 rubles for breakfast, 30 for dinner, 4 for tea, and 25 for supper. If you eat caviar and drink wine or cognac, you may go over. That means extra coupons or added cash. If you run under, that's your loss. If you end up with spare coupons, trade them before you leave to the maitre d'hotel for vodka, chocolate, cigarettes, or caviar. (A chocolate bar costs about as much as a jar of caviar—so choose wisely.)

10. If you are a poor drinker, watch your step. At a major meal, the Soviet citizen can down five or six vodkas, each at a gulp after a toast, then drink wine with each course. The noon meal is gargantuan and vodka is not as heavy as bourbon or Scotch—but it gets there just the same. A typical lunch may start with sliced smoked fish, sausage and cheese with bread, followed by a large plate of soup with meat—then the entree: meat, potatoes, and vegetables. Then a "compote" (a glass of plum or apricot juice with three or four whole fruits in it), or ice cream. With drinks, you'll be asleep after that.

11. Expect no newspapers or magazines from the US to be available. They aren't—only the London *Daily Worker* and equivalents. You'll be completely out of date, US news-wise, if you stay in the USSR for any length of time. And don't expect the Embassy or consulates to help greatly. As one attache said to me: "There are two groups in the USSR which rank below tourists: diplomats, and resident correspondents."

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WARNER

electric motion control FACTS

Electric clutch is quick-acting power link for instrument drive

PROBLEM: This unique instrument for reading 80 bits of data simultaneously from a 1-in. perforated tape was designed to test individual components and voltages in electronic assemblies. The drive problem was to accurately and automatically rotate the tape feed drum one frame of ten lines for each index, or reading. Wire-mesh fingers on the readout head drop through the tape perforations and contact a silver-plated drum. A matrix of 80 lamps on the front panel indicates fingers that are making contact.

SOLUTION: The tape index drive system consists of a continuously running motor, an electronic control unit, and a Warner electric clutch-coupling. When the power supply energizes the clutch field (10-millisecond pulse for each 60-deg index), torque is transmitted as the result of electromagnetic attraction of the clutch rotor and armature.

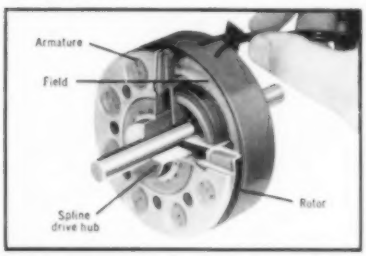


Fig. 1—Warner electric clutch-coupling operates on direct current and requires a maximum of 10 watts to produce rated torque.

The Warner clutch used is the stationary-field type, which consists of one stationary and two rotating parts. The stationary member is the field, mounted on a free-running bearing to the intermediate member, or rotor. A torque arm restrains the field from rotating. When the clutch is energized, flux flows from the field into the rotor and then to the armature. The rotor attracts the armature, mounted on a splined hub to the driven shaft, for coupled driving. Driving occurs on a slipping condition—drum rotation never reaches motor speed.

Completes 60-deg index in 30 ms

The clutch is in the plate circuit of a type 6BG6 tube and is energized for about 10 ms. Parts are accelerated for about 9.5 ms and a torque of about 8 in.-lb. The drum reaches 490 rpm max. for each index. To build up current in the field, engage the armature and rotor, and start rotation of the drum requires only .5 ms.

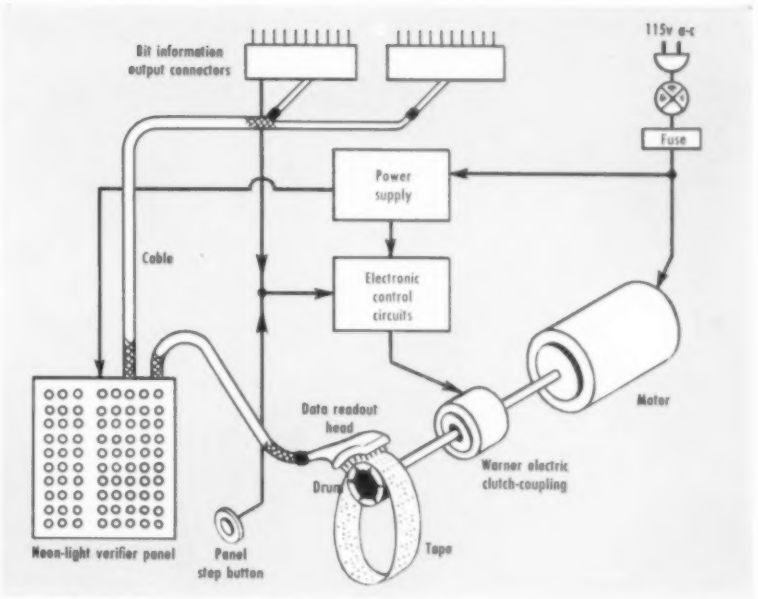
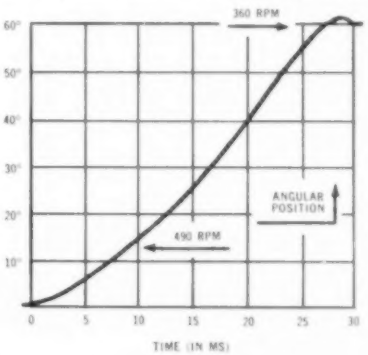


Fig. 2—Drive system for step-indexing the tape drum consists of a continuously running motor, a Warner stationary-field electric clutch, and an electronic control unit. Drum rotation is controlled so as to move the tape one frame of 10 lines for each reading.

Clutch maintenance minimized

The stationary-field clutch eliminates the need for slip rings and brushes, permits easy, quick replacement of friction surfaces without disturbing the field or electrical connections. Friction is between the rotor and armature, either of which can be replaced quickly. When attracted by the rotor, the armature floats axially on a splined hub into full contact. This mounting provides automatic wear compensation, eliminates downtime and adjustments.



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Detailed design data with typical applications, properties and characteristics of GRAPHITAR, are included in Bulletin #20. Write us today—on your letterhead —for a free copy.

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